Tappi

PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

DECEMBER 1950

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Calco

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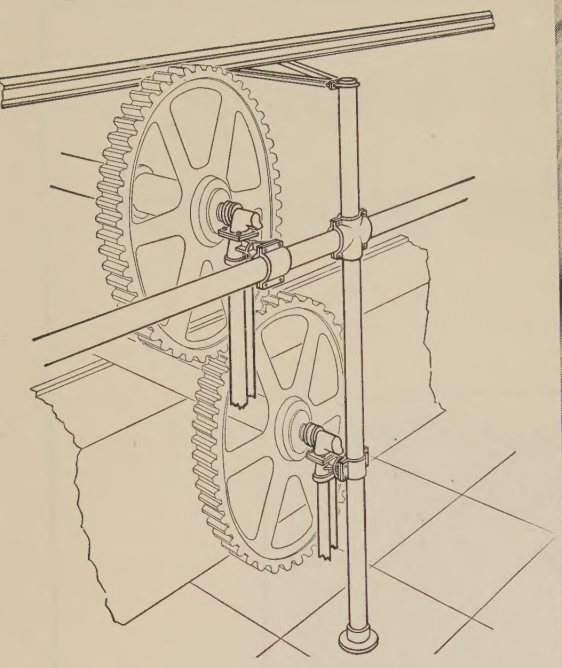
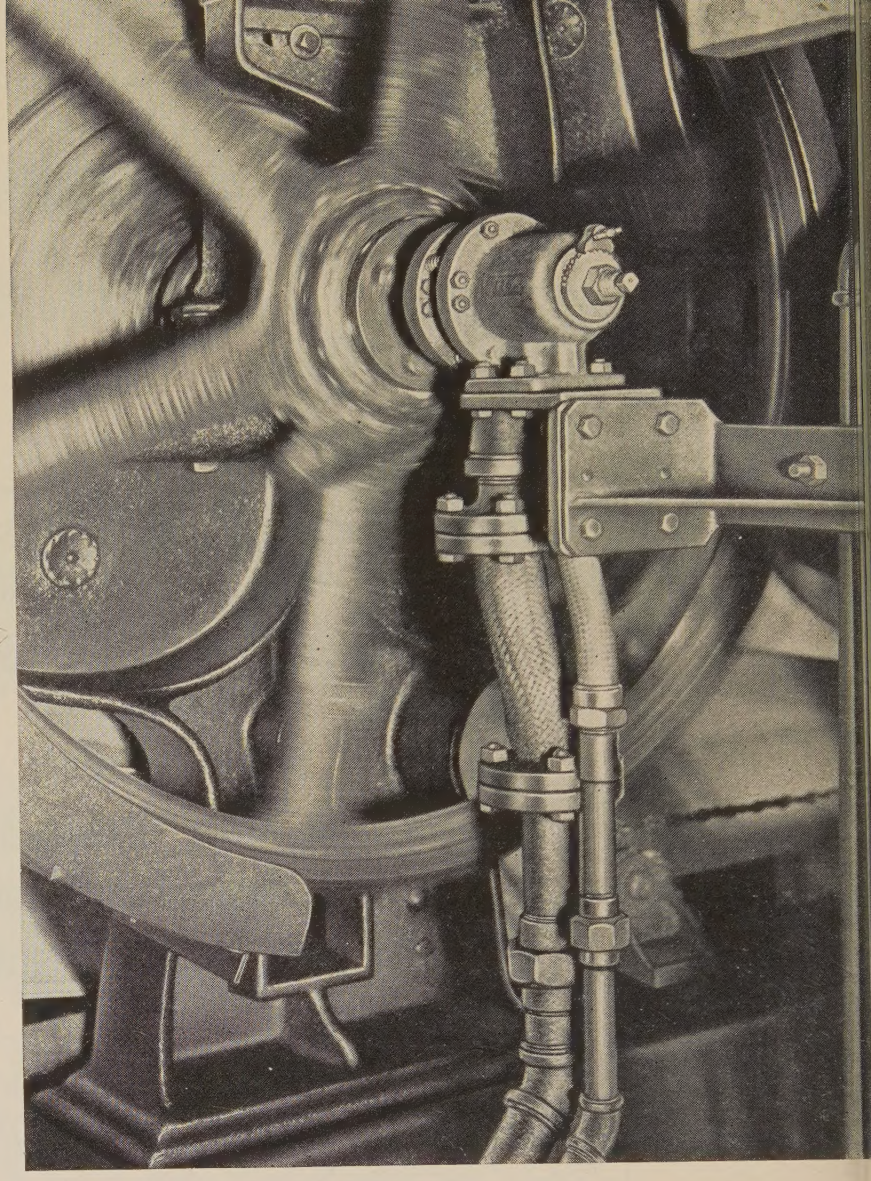
The DRAPER Felt



The Puseyjones Improved Steam Joint on Dry Part having open-type gearing. This requires special outside pipe structure which serves to maintain exact alignment and minimum power consumption at all times. The flexible pipe connections incorporated in the steam and water piping compensate for any expansion or contraction in the supply headers and branch connections. In case of drop siphon, this may be adjusted to suit speed conditions by means of an extension as shown in end of steam joint.



New Life for Old Dry Parts

(A Case History)

In a prominent northern mill having six old machines, a rebuilding program was undertaken requiring an increase in speed and production. As additional power was limited, a trial installation of four Puseyjones Steam Joints and Siphons was made and results checked carefully.

So satisfactory were the economies obtained in power reduction and maintenance, combined with more efficient evacuation of condensate, that 64 additional units were installed to completely equip two machines.

This was later followed by an installation of 85 Puseyjones Steam Joints and Siphons to completely equip two more machines.

These four "old" machines are now operating at even higher speeds than were anticipated in the rebuilding program.

If you are interested in this subject, Puseyjones suggests a thorough study of the "Steam Joint Bulletin". Write for your copy today.

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Established 1848. Builders of Paper-Making Machinery

Fabricators and Welders of All Classes of Steel and Alloy Products

Wilmington 99, Delaware, U.S.A.

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DECEMBER 1950

Tappi

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Mr. Beesting, can you expedite those three pulpstones that I ordered last week? We are changing grades and need them sooner than expected.
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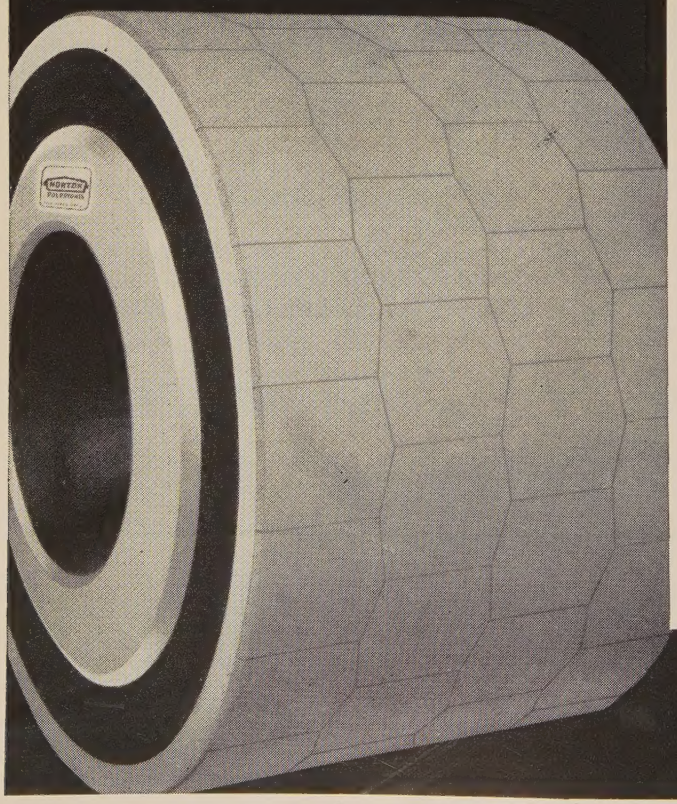

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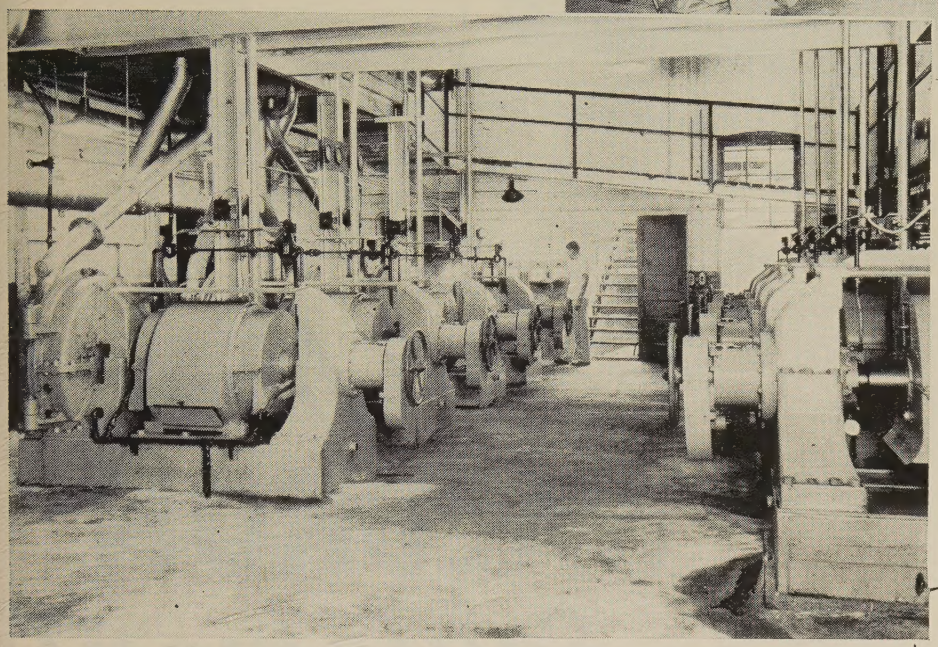
NORTON
PULPSTONES

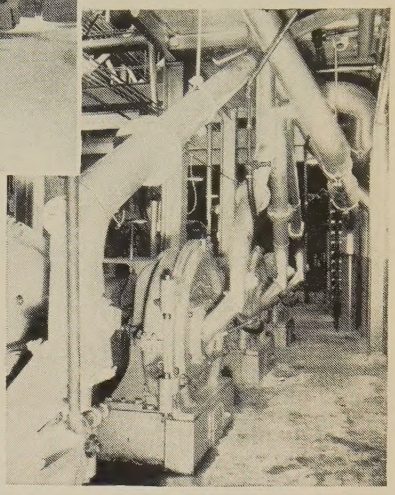
Mills that compare Refiners

Front view of primary stage 400 H. P. refiners. First two units operating on shredded knots and screenings . . . note discharge spout from shredders.

Last three units operating on semi-chemical chips . . . note flexible dilution water lines and electric cable—swing head door side.



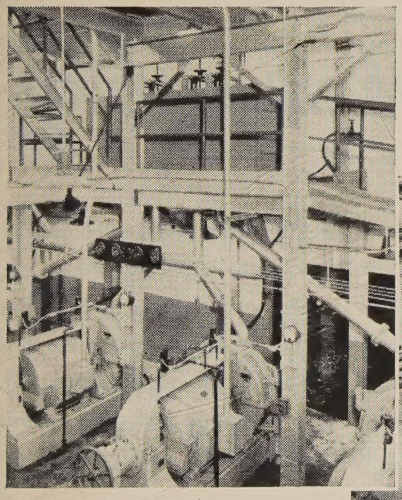
Four 300 H. P. secondary refiners (on left) . . . note stock inlet piping—lubrication oil-flow indicators, and compact arrangement of instrument panel.



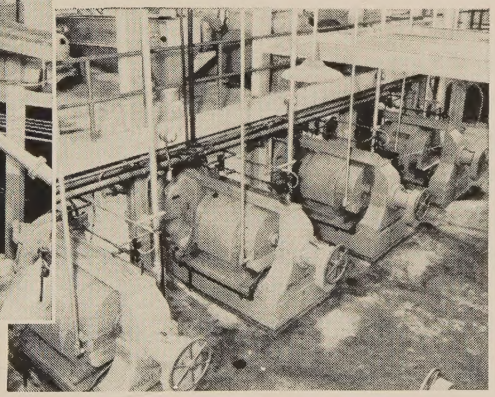
Front view—secondary stage refiners, showing stock inlet piping arrangement...note dilution water line at refiner intake.

The GAYLORD Installation
A battery of 9 Sprout-Waldron Refiners at the Bogalusa, La. plant of Gaylord Container Corp.

choose Sprout-Waldron



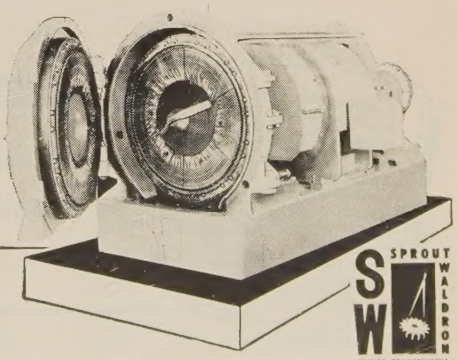
Individual view of secondary stage refiner illustrating stock handling system from regulating box to refiner . . . note ammeter, dial indicator and oil flow indicators.



Top view—primary stage refiners. Two units in foreground on semi-chem chips . . . note dewatering unit directly overhead.

Two units at extreme end operating on knots and screenings . . . note Jeffery shredders located directly above. Note dial indicators—tail end.

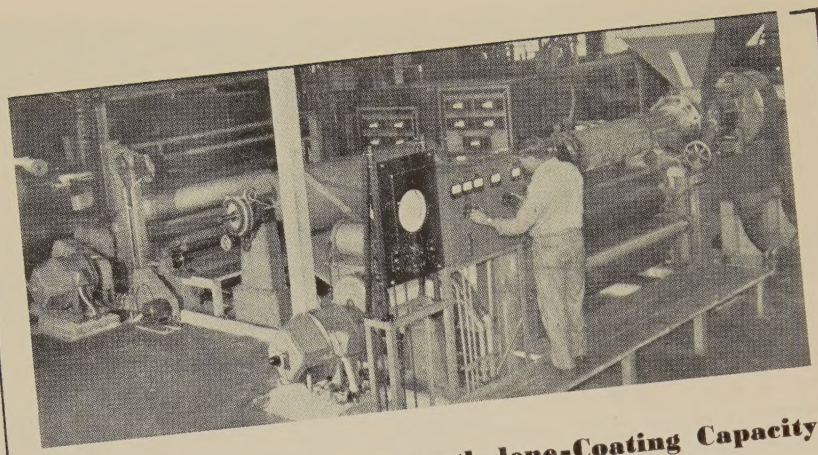
Sprout-Waldron Refiners, or "Sprouts" as they are dubbed in the industry, are sprouting up in mills all over North America. Let one of our field representatives tell you the facts about the fast-growing popularity of this equipment. Or, write today for Bulletin 41 to Sprout, Waldron & Co., Inc., 38 Waldron St., Muncy, Penna.



—Sprout-Waldron
Manufacturing Engineers
SINCE 1866
MUNCY • PENNSYLVANIA

165

Reproduction of feature article published in American Paper Converter, Sept. 1950 issue, showing an actual installation of the real thing in extrusion coating machinery—not just an artist's conception or blueprint.



St. Regis Expands its Polyethylene-Coating Capacity

FACILITIES for coating kraft paper with polyethylene have been tripled by St. Regis Paper Co. to meet the demand for specialty papers and multiwall paper shipping sacks containing this thermoplastic protective barrier ply.

The company, working at a stepped-up tempo to meet new demands for plastic coated papers, announced that its second, and larger polyethylene coating machine has been placed in commercial production at the Carthage, N.Y., paper mill. A coater believed by St. Regis to be the first to be built by any multiwall bag manufacturer went into operation more than a year ago at the St. Regis bag plant in Oswego, N.Y.

St. Regis finds that kraft papers coated with polyethylene have many important uses in today's economy, above and apart from the shipping sack applications. Polyethylene is particularly adaptable as a protective barrier ply in wrapping machinery and equipment parts to prevent corrosion during transit. This factor is particularly important for military transport purposes, and is expected to open many possibilities as new military utilizations are found for the product.

Considerable tonnage in polyethylene-coated papers is being sold on the open market, to manufacturers not only of multiwall bags but also to meet a wide variety of different types of packaging requirements and specialty applications, St. Regis said.

The company originally undertook its polyethylene coating development program with emphasis on its applica- for industrial and agricultur applications, and also specialty ar- tions such as frozen food packaging. The company adopted the trade name "Plyolene" for multiwall bags containing the inner ply of polyethylene-coated kraft paper, and "Poly-Wrap" for its polyethylene-coated paper used by frozen food locker plants and their customers.

The new Carthage coater will enable St. Regis to triple its production of polyethylene-coated papers, the company says. The Oswego machine will continue in regular commercial production as well as experimental operation in seeking new coating thicknesses for use in the packaging industry.

Major parts of the new 10-ton coater were built to St. Regis specification. The machine is designed to operate in a range from 50 to 600 feet per minute, depending upon the required thickness and adhesion of the polyethylene coating. Volumewise, the machine has a capacity of upwards of 3000 pounds of polyethylene-coated paper per hour in any width up to 90 inches.

The machine at the Oswego plant has a 1,000 pounds of coated paper capacity per hour and a 54-inch maximum trim.

The Carthage coater offers a wide range of commercial coating thicknesses, from one-half to seven mils. However, most commercial coatings to date have been 1-½ mils, which is approximately equal to 20 pounds of polyethylene per ream of 24x36 inch paper. Indications are that coatings as low as 5 pounds may become commercially practical, although the thinest comm- cial coatings under- -wall bag field have re- ire-

St. Regis, working with E. I. duPont de Nemours and the Bakelite Corp., manufacturers of polyethylene resins, claims to have developed this coating process which made it economically possible to adapt the plastic to this phase of packaging.

Tests conducted in its own and by outside labor- ies, the company reports, developed xtent to which polyethylene may tt to work in the packaging industry eo indicate the riety of pro- bi l ec ically in p gs p ent on ammoni- ored bags containing either the polyethylene-coated or the asphalt-laminated barrier ply re- in favor of the pol to- st e con to c d m abs mu cont fls of ku te es polye ene ts. O asphalt-laminated calcium chloride determined the strength characteristics of p types of bags, and again the l e bag proved superior on all ts, according to reports .

Of par- inter di in conn- ns, ammonium fertilizers, e, borax, in the chemical field; trimmings, dried milk and milk by-products, powdered eggs, and fro food packaging, in the such miscell na-

here's how WALDRON Equipment speeds up polyethylene coating

As stated in the article shown above, St. Regis Paper Co. has tripled its facilities for polyethylene coating of Kraft paper with its new coating equipment at Carthage, N. Y. Besides providing the greatly increased capacity, the new coater is capable of applying the widest possible range of coating applications at speeds ranging from 50 to 600 ft. per minute.

In view of the tremendous field now opened for the use of polyethylene coated papers, WALDRON is justly proud to have built the coating equipment (except extruder) for this outstanding processing development at St. Regis Paper Co.'s Carthage mill. More proof of WALDRON leadership in web process engineering.

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Facsimile of the first-known Christmas Greeting Card. Original now on display in the British Museum in London.

The First Christmas Card

When, in 1842, William Maw Egley, a young London engraver's apprentice, produced the first-known Christmas card, he started what was destined to become both a popular custom and a major industry. While the Christmas card originated in England, the sending and receiving of greeting cards has attained its greatest popularity in America. Today more than two hundred greeting card publishers produce more than three billion cards annually. It is estimated that nearly one hundred million dollars is now spent each year to mail greeting cards of all types and for all occasions—a sum representing approximately ten percent of the Government's first-class mail revenue.

In reaching such a vast volume, greeting cards have become one of the largest users of paper, and thus have made an important contribution to the swift, continuous growth of America's pulp and paper industry.

The dramatic story of paper is told in the sound-and-color film, "Paper — Pacemaker of Progress," and in a book under the same title. Both are presented by F. C. Huyck & Sons as a tribute to the Paper Industry. The book will be sent free upon request.

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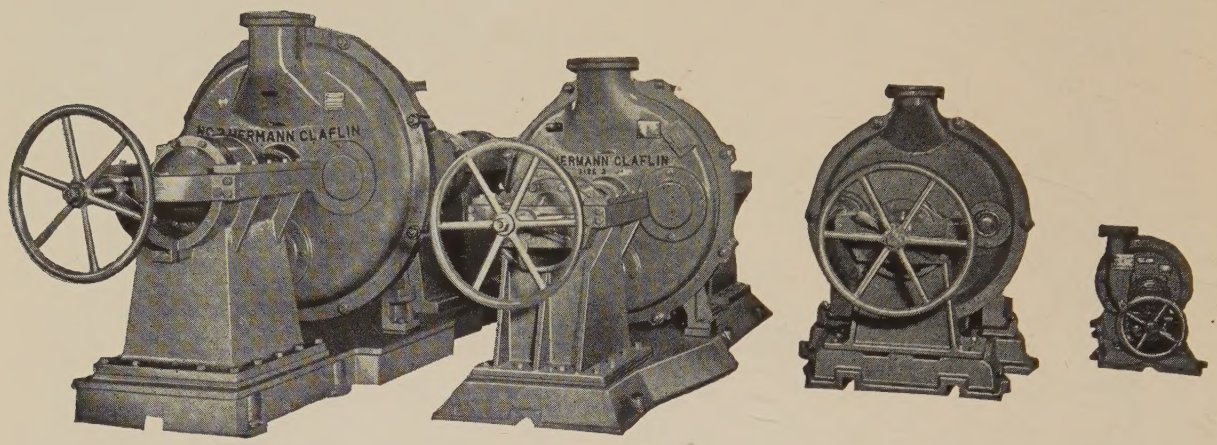
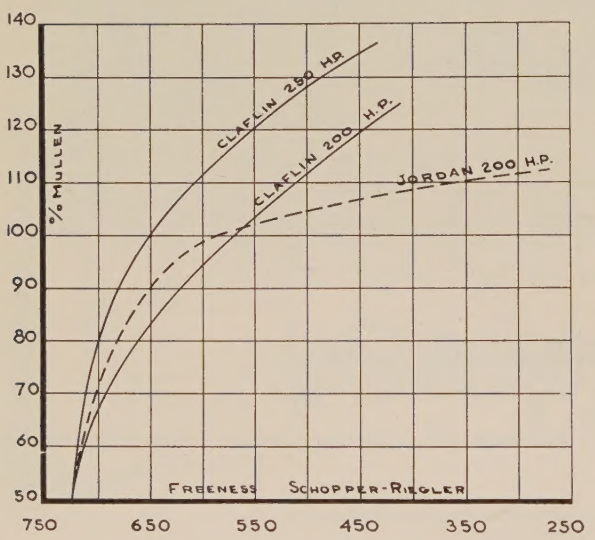
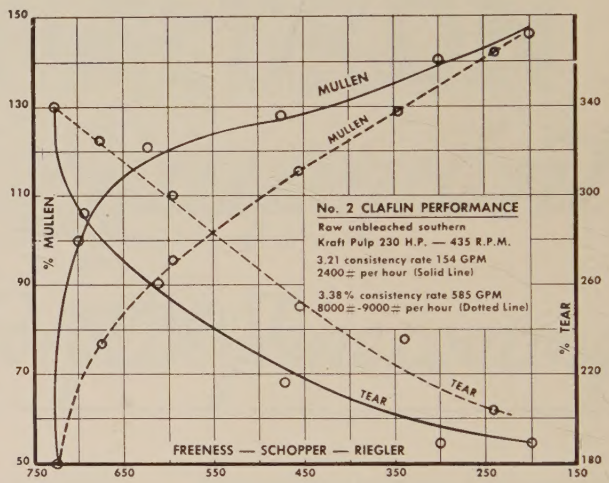


CLAFLIN PERFORMANCE—COMPARISON



NO. 2 CLAFLIN-HYDRATING FILLING.
JORDAN—¾" SHELL FILLING & ½" PLUG.
UNBLEACHED SOUTHERN KRAFT PULP.



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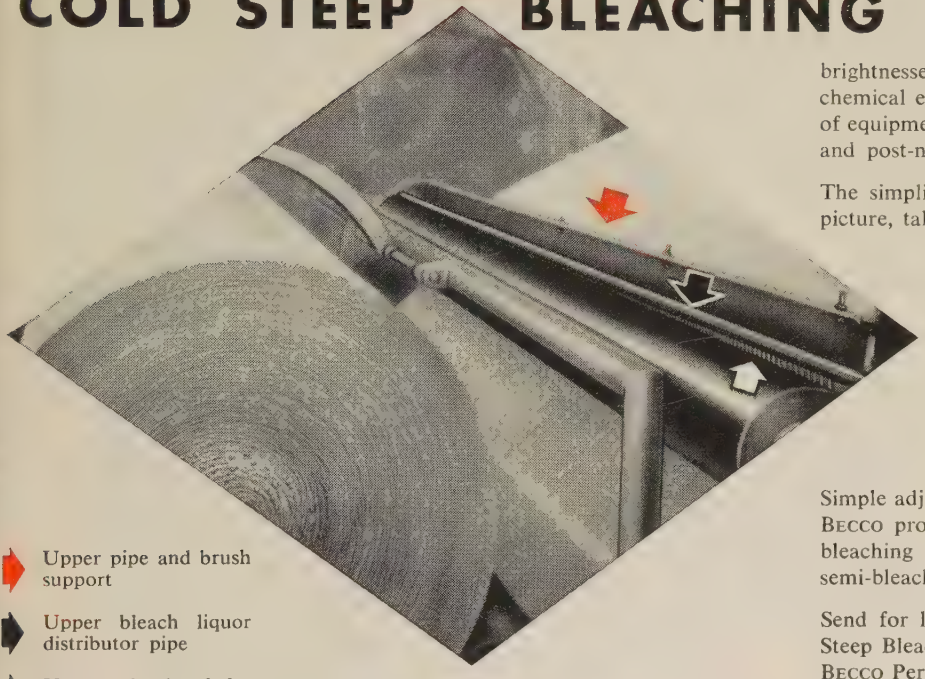
WESTMINSTER *uses* BECCO H_2O_2 IN COLD STEEP BLEACHING



Upper pipe and brush support

Upper bleach liquor distributor pipe

Upper nylon brush for spreading liquor

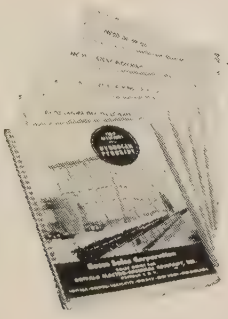
Through the cooperation of Westminster Paper Co., Ltd., BECCO has completed the mill development work and commercial application of this new high density process, now in its 18th month of successful use.

The new process permits bleaching of groundwood pulps to brightnesses as high as 70-74 . . . at highest chemical efficiency on the simplest sort of equipment. Pulp mixers, retention equipment, and post-neutralization are eliminated.

The simplicity of the process is shown by the picture, taken in Westminster's mill in New Westminster, B.C. A 2-roll padder transfers Hydrogen Peroxide bleach liquor of controlled alkalinity to one or both sides of a high density web. Then the rolls (or sheets) are stored for two or more days at the mill or in transit and thereafter are ready for paper furnishing.

Simple adjustments of formula adapt the new BECCO process for equally efficient bleaching of sulfites, semi-chemicals or semi-bleached krafts.

Send for literature on the new BECCO Cold Steep Bleaching process or on other uses of BECCO Peroxygen chemicals. BECCO SALES CORPORATION, Sales Agent for BUFFALO ELECTRO-CHEMICAL COMPANY, INC., Buffalo 7, N. Y. • Buffalo • Boston • Charlotte Chicago • New York • Philadelphia



BECCO SALES CORPORATION, Buffalo 7, N. Y.

Please send me literature on:

(P-2) . . . BECCO COLD STEEP BLEACHING PROCESS

(P-1) . . . Pulp Bleaching with Hydrogen Peroxide

(P-3) . . . Peroxide De-inking

(P-4) . . . Glassine Bleaching

(P-5) . . . BECCO Laboratory Bleaching Methods

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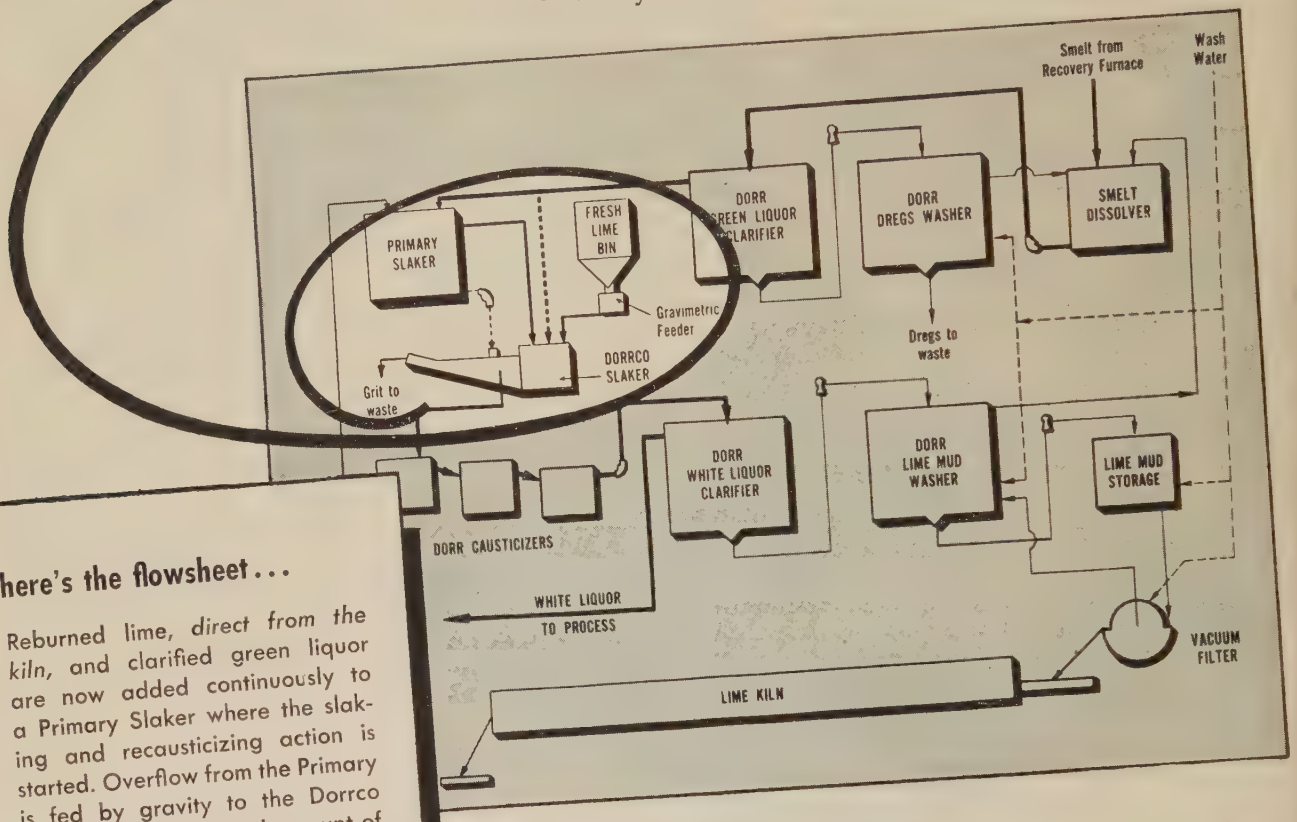

here's the flowsheet...

Reburned lime, direct from the kiln, and clarified green liquor are now added continuously to a Primary Slaker where the slaking and recausticizing action is started. Overflow from the Primary is fed by gravity to the Dorrco Slaker and a measured amount of makeup lime is added. Slaking is completed in the Dorrco, which produces a clean milk of lime and a washed, separated grit. The remainder of the flowsheet is the standard Dorr System.

here are its advantages...

- Troublesome handling of hot lime is reduced to a minimum . . . need for reburned lime bin is eliminated.
- Accurate weighing of makeup lime results in "end point" control with no over or under liming.
- Uniform white liquor strength is maintained regardless of fluctuations in kiln discharge.

If you are interested in alkaline pulping processes, write for a new bulletin #3301 describing the Dorr Continuous Recausticizing System in detail.

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TAPPI

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ANSONIA, CONNECTICUT

Please send me, without cost or obligation, a copy of Bulletin No. 117, "FARREL PAPER-MACHINE AND BOARD CALENDERS."

Name ..... *Title* .....

Company .....

Address .....

City ..... *State* .....

This *NEW* booklet describes and illustrates FARREL paper-machine and board calenders.

Rolls, housings and loading devices for paper-machine calenders are described, and possible variations in types of roll bearings and roll lifts are pointed out. Illustrations show calenders ranging in size from 91" to 236", and typical installation views are also included.

The construction of two-roll board calenders is also discussed in detail. Various types of top-roll adjustment mechanisms, which can be furnished to meet individual requirements, are described. Among the illustrations is a photograph of the largest two-roll board calender built to date.

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Farrel-Birmingham®

A Banker Looks at the Pulp and Paper Industry

A. NEWELL RUMPF

It is a pleasure to meet with you, and it is hoped that my words will be interesting and perhaps somewhat helpful to your thinking; but I must confess in extreme humility that I have constantly lived in awe of your illustrious organization. I have attempted to read intelligently some of your papers and confess to having dozed during sessions at the Executives Conference of The Institute of Paper Chemistry. Yours is in the main a scientific body and being possessed with no talents whatsoever with test tubes and only a smattering of physics, I can hold forth with comments on the only trade I know—banking in several of its phases.

I do not profess to be an economist, but rather one who has spent his business life in the financing of municipalities and corporations, 12 of these years as an investment banker and 9 as a commercial banker—the last period being the most pleasant, largely due to an attempt to learn what makes the pulp and paper industry click.

First off, a banker has a commodity for sale no less than the end product of your respective plants. In a banker's case, it is credit which is as intangible a commodity as can be imagined; and while I do not have any order blanks with me, I should like to spend a few minutes in giving you a brief sales talk.

Credit, of which loans are one form, is a most vital fluid in our economic machine. Credit has made possible our high industrial development which in turn has given our people the highest standard of living in the world. The whole structure of modern commerce is built on credits, and banks are agencies through which much of this credit is cleared.

Banks must be interested in the success of their customers and give them service. Loans are one form of service, and the interest received on these loans is necessary to pay overhead, salaries, and to maintain the structure on which the bank's business is carried on. Contrary to the opinion of many, banks actively seek loans. Also strangely enough, unsecured loans are the most desirable for the bank, as they involve a lower cost of administration. Even where the loan to a business is secured, the banker looks forward to the day when he may safely and properly loan without collateral. The banker is not doing a customer a favor when he loans him money—*credit is the commodity he sells and that's his business.*

There are certain fundamentals that the technical man should understand as well as those engaged in administration. A successful mill must be backed by an intelligent financial program as much as virile and sound research and production divisions. It takes money—lots of it—to run a paper mill. Failure to intelligently expend this money may easily ruin the enterprise. It must be spread over production, administration, research, and sales; and the vast sums required just don't happen. Money, while there is a larger amount in circulation today than ever before in the history of our country, still can't be picked off the trees.

How does a company procure capital when it is needed for current operations or for plant betterment and expansion? Generally they consult with an investment or commercial banker. Both have their place and seldom do their functions cross. They complement rather than compete with one another. The investment banker acts chiefly as a procurer of equity and long-term capital. To a large extent this is a "one-shot" deal, since once established, the capital base does not greatly change over a considerable period of time. The investment banker is often an investment house which through its buying department conducts an investigation in behalf of a syndicate which subsequently distributes the securities to the public. He may attempt—insofar as the securities law will permit—to maintain an orderly market in these securities through the dissemination of information concerning them in later years, but his direct contact with the operation is negligible unless trouble ensues.

The commercial banker concerns himself largely with the extension of short-term financing with the balance sheet as his chief financial tool. Current loans are granted to provide funds to meet liabilities due within a year and to assist the company in the conduct of its business to the extent that its operations are seasonal in character. These loans may be secured or unsecured, depending largely on the balance sheet. A paper mill may purchase foreign pulp and find it advantageous to take up its commitments in the fall for processing during the winter months. The end product may be seasonal in its usage, but its production curve must be level—hence the borrowing to provide for an unusually large seasonal inventory. Our concern as a commercial bank lender lies less with the fixed assets and more with the working capital.

Of great importance is the continuing relationship maintained with the company. I have in mind one substantial paper company which has had an account with us for the past 31 out of our bank's 43 years of existence. We value highly this relationship and have been identified with every bank financing made. I am sure that the president of this mill would tell you of our helpfulness, and most certainly it has been a profitable account for us.

Until the last decade few bank loans were made to industry with a maturity beyond 1 year. It is not now unusual to find banks negotiating loans up to 7 years—and even 10 in a very few cases—to sound business. We ourselves have made many such term loans and the outstandings on our books are many millions of dollars.

A. Newell Rumpf, Vice-President, Harris Trust and Savings Bank, Chicago, Ill

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I know of no such loan to the paper industry which has defaulted and few have had to be reset. I credit the intelligent study made prior to the granting of such loans as the chief reason for this record.

CREDIT FACTORS

This talk was not designed as a credit study. Nevertheless, a short review of the credit factors which underlie the extension of credit will not be out of order. What do we as bankers look into as the basis for our deliberations and decisions?

1. Character and ability of management. This is determined from experience with the individuals who have the responsibility of the conduct of the enterprise, and from their past record and history. The ability is a matter of opinion and appraisal of individuals, with the operating record a yardstick of measurement. A well-rounded organization, with capable individuals in charge of their respective divisions, is an important consideration. Frequently we encounter family situations, one-man managements, or controls in jeopardy for some reason. It is important to know of any factional disputes, and in certain cases, to ascertain if voting control is vested in the management.

2. Financial. If we could take a statement and by analyzing the figures *alone*, assure ourselves regarding the standing and goodness of a risk, the matter would be a simple procedure. A financial statement can be divided into several parts. The assets are of two major classes: realizable and nonrealizable. Realizable assets are of two kinds—those considered current or realizable over a short period, such as cash, collectible notes and accounts receivable, inventories, marketable securities, and cash-value life insurance; and those not liquid nor current, i.e., fixed investments, such as machinery, plant, or property—generally a permanent investment to a continuing business. This latter type of asset, while necessary to business, is not given much weight in a statement by a short-term lender, except possibly as a basis of analysis to assure ourselves that it is not out of proportion to the capital investment. The proportion differs with the type of industry and it would not be fair to give any figure of percentage in this general discussion. A nonrealizable asset, as the term implies, consists generally of good will—although this at times may have a value in the case of a sale—and the item of deferred or prepaid expenses, such as advertising, insurance, dues, and possibly other items.

3. Operations. We are naturally interested in the earning record and examine the profit and loss statements for a period of years. If the record of an individual company runs counter to the industry trend, a red flag appears. The progress, or lack of it, is further reflected through a study of the net-worth position over successive years. Other factors under this heading will include plant efficiency, banking performance and trade record, overhead expense, organization morale, and labor relations.

4. Prospects. The degree of essentiality of the product and the competitive position of the company. A projection of operations, intelligently conceived, is a valuable tool to the credit analyst. Here we must also examine the capital expenditures or plant expansion contemplated and be assured of the financial ability to conduct this expansion. The further development of the product and the potential expansion of sales at a profit are, while intangible, an essential item to the study.

Other Considerations

I must emphasize that caution be exerted to distinguish credit information from gossip. Fundamentally there are no secrets in business; and while we protect the confidence of our sources of information, we always want to be careful to sift out the scuttlebut from the facts.

Obviously, a question comes to your mind as to the extent of our technical knowledge, and I am very frank to say that I know of no banker in a central bank who has ever actually been engaged in the paper industry. After making a substantial number of visits and hearing the operations explained by those in a position to know, we in time become pretty good judges of the operations and are able to determine pretty well through comparison as to the productiveness of the equipment and facilities. A most important impression is gained through the housekeeping in the mills. Where we see a large amount of water on the floors, dripping pipes, poor lighting, and have to dodge around bales of pulp and finished product, we are almost always certain to find that same poor housekeeping in the financial department. Naturally, we interest ourselves in the size and speed of the machines, as well as their versatility and the manner in which the buildings themselves are maintained.

Doubtless you have wondered at the banker's source of information on your industry. It is certainly no trade secret and briefly consists of sticking our noses into every spot where we feel that our fund of information can be enhanced. First and foremost, I adhere to the theory that nothing in the way of knowledge of a company's business is better gained than through personal visits at the home office and trips through the mills wherever situated. Naturally I like to visit with the top brass because of the broad experience and understanding which these men have, but I also enjoy talking with production, sales, and research men. I have probably bored a dozen of you gentlemen in times past, but have always come away from your desks with a fuller acquaintance of your doings and problems. Literature on the paper industry is prolific and we subscribe to trade publications and receive considerable industry data from such sources as the Department of Commerce and the American Paper and Pulp Association. In short, an attempt is made to understand the underlying problems of the industry and follow with more than passing interest new facilities being added, new methods of production, and new products. Naturally the financial reports of individual mills are read and analyzed. Often these statements come to us in confidence and in detail so that over a period of years a definite impression of the operation of an individual mill, put together with the others, gives a definite feeling as to the over-all status of the industry.

INDUSTRY EXPANSION

Much has been said and written about the expansion of the pulp and paper industry, particularly since 1945. Accordingly, I will only review a few figures—figures already well known to you, as a basis for some later

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comments. Since 1945 the productive capacity of your industry has increased from 19.4 million tons to a rated capacity of 24.2 million tons in 1949. Much has been said lately of the increase or, as some claim, lack of increase on the part of the steel industry. The figures given me indicate that their capacity has increased over the same period by 5.1 million tons. Percentagewise the paper increase, amounting as it does to 26.3%, compares most favorably with the increase in steel capacity of 5.4%. Both have naturally outstripped the increase in population and, in the case of the paper industry, reflect deferred expansion brought about by an early misconception of the essentiality of paper products during a large part of World War II.

Looking at total assets, we find reliable sources indicating an industry figure of 4.89 billion at the end of 1949. This is a substantial increase over the 2.97 billion figure at the end of World War II. This was in part due to the deferred maintenance, modernization, and improvement accumulated during the war years and bunching up of plant and equipment requirements. We must not overlook the need of spending more money for pulpwood requirements and the replacement costs of all equipment with the high cost of property additions against original cost.

Productionwise the period since the war shows a trend of from 17.4 million tons in 1945 to 22.1 million tons in 1948. The industry slipped in 1949 to 20.3 million tons but forecasters are prophesying close to 24 million tons in 1950, which is just under rated capacity.

Much has been said about consumption, particularly on a per capita basis, and with a national population of slightly over 150 million, per capita consumption is around 358 pounds. It is only necessary to go back to 1940 to find a per capita consumption of 254 pounds. Plainly, paper has found its place in the sun and has nowhere near reached its apex.

NEW CAPITAL

The face of the capital market as it looks to a business corporation in need of new capital has not changed its expression very much in the last five years. The president of a good middle-sized company needing a reasonable amount of new capital for plant expansion and increased working capital will find on inquiry that he can borrow money up to 20 years or more at a low rate from life insurance companies and banks and, generally speaking, from nobody else. Dr. Ruth E. Shallcross at The Institute of Paper Chemistry made an interesting study early this year regarding investments of insurance companies in paper corporation securities which revealed that over 250 million of bonds and 28 million of paper industry stocks were held by the larger life insurance companies at the end of 1948. Doubtless banks additionally hold another 150 million of debt which would leave in the hands of the public less than 100 million of the estimated 500 million of funded debt outstanding by the industry.

There's quite a range in rates of interest charged. Depending on the type of business, the margin of safety in property, maturity, earnings and all the terms—I'd say the range is from $2^1/_2$ to $4^1/_2$%. Interest is a deductible expense, so with the new 45% tax rate, the actual cost of such money after taxes is from 1.40 to 2.40%. Preferred stock money will cost at least twice these net figures and probably much more than twice unless trimmed up with a strong sinking fund or the privilege of conversion into common.

And when he asks about selling some common stock, he finds that it takes a rather glamorous company to sell common shares at more than 7 to 10 times current earnings per share. In other words, if the money is borrowed, there will be no dilution of the earnings per share on the present common stock if the new money can be made to earn about 3% before taxes, whereas if common stock is sold, the new capital will have to earn about 12% after taxes, or earnings on the present shares will be diluted. And the difference is still wider because a loan can be arranged with relatively slight expense. No S.E.C. registration is necessary for a privately placed loan. All that is needed is to commission a good investment banking firm to act as agent to find the institutions that will make the best terms and to drive a good bargain on the rate and other provisions, plus a modest legal bill for drafting the loan agreement, and a little printing expense, or to go direct to a commercial bank who is willing to make a reasonably short-term loan. Stocks, however, nearly always have to be registered with the S.E.C. for public distribution and to cover this as well as the risk of underwriting and the expense of selling to numerous investors, the whole bill of costs may well amount to from 7 to 10% or more of the selling price of the shares. When faced with these facts of life in the present capital market, a company president naturally feels he hasn't much choice.

How do these capital-market conditions compare with other times? Here I am going to rely on my memory rather than look up official statistics. Common stocks of good paper companies sell today at 6 to 9 times current earnings, while I'd say that most of the time during the 20 years I've been on La Salle Street, it has been the rule for these stocks to sell at 10 to 15 times earnings. One reason, of course, is that less than 40% of current paper-company earnings are being distributed in dividends while distribution of 65 to 70% used to be usual. Obviously, the dividend yield is still higher than usual, ranging generally from 5 to 8%, while the interest rate on corporate bonds, in the neighborhood of 3%, is the lowest ever, except for a short time a couple of years ago. I'd guess that the 20-year average on industrial issues of fair quality was at least $4^1/_2$%. These are very broad generalizations, but I think they will serve the purpose of showing that the present spread between the markets for loan capital and common share capital is unusual and extreme.

In view of these conditions, it will be no surprise to find that recent reliable estimates place new capital issues aggregating over 4.9 billion dollars during 1949, with approximately 82% bonds and notes and only 18% stocks. If some of the term loans by banks were added to the debt part of it, which would seem logical, the percentage of stocks would be lower than 18%. In the paper industry, well-regarded sources estimate that during the period 1945 through 1949–$103,500,000 was obtained from common stock, 90 million from preferred stock, and 550 million from debt financing. Accordingly then, with stocks representing between only 15 and 20% of current over-all new financing, it is no

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wonder that a good many economists come to the conclusion that due to the scarcity of venture capital, American business is wrecklessly headed down the royal road to ruin.

Obviously there is much to be said on the other side, and many students agree that while the shortage of equity capital, if it continues, will be a serious matter, they hasten to point out that including a huge amount of retained earnings, the cushion of owners' capital back of the debts has actually increased substantially in the postwar period (this is in spite of Section 102 of the Revenue Code). One authority places the retained earnings in 1947 at around 10.6 billion dollars and the figure for 1948 at about 11.5 billion. Figures for 1949 are close to the 1947 figure. In the paper industry it is estimated that over 1 billion of retained earnings have been added to the balance sheet since the end of the war. Last year, for example, net earnings after taxes were estimated at 426 million, which left 249 million after dividends of 177 million. It will be noted that retained earnings exceed the amount of new capital acquired from the public.

I do not intend to go into the reasons for the lack of interest in the equity market at the present time other than to mention several which obviously come to mind as remedial measures: (1) the abolition of double tax on corporate profits, (2) the abolition of capital gains tax, (3) reduction of margin requirements.

I also do not wish to categorically infer that all companies in your industry and others have nothing but a dismal future before them by having contracted, in the over all, too much debt, and put off raising additional share capital they ought to have. I believe that the sound financial policy for business is to face the difficulties and raise money by the sale of common stock in the market regardless of price, if that is necessary to maintain a sound and safe capital structure. The only people financially injured by a sale of stock at a low price—that is below book value—are the stockholders of the company and they should have the right, through pre-emptive rights, to offset the dilution of their old investment by making a further investment in the business on advantageous terms. Technical men, together with management and bankers, are well aware of the cyclical nature of the paper industry—although our thinking may be a bit clouded by the prosperity which has been recorded in the last 10 years. The swings have been modest and for the most part—excluding the price control period during the last war—a sellers' market has been in vogue. Nevertheless an over extension of debt by individual mills proved to be a ruination of more than one company in the last 50 years. Many examples of bankruptcy in your own area could be cited, and in almost every case the over-indebted position of the company rather than changing conditions and poor management was responsible for bringing the sheriff with his tack hammer to the front door. Those bankrupt mills were often bought in and rose to bite its competition, by starting a price war which adversely affected all mills.

Many of you have wondered at the greatly increased profits of such concerns as International, and I submit that since 1945 this company has paid off 46 million of debt and now is a debt-free mill. Out of 15 corporations whose stocks are listed on national exchanges, five have no debt—namely, Great Northern, International, Hinde and Dauche, Scott, and West Virginia. The last three have had no funded debt the last 5 years. Of the remaining ten, six have increased their funded debt while four have reduced it.

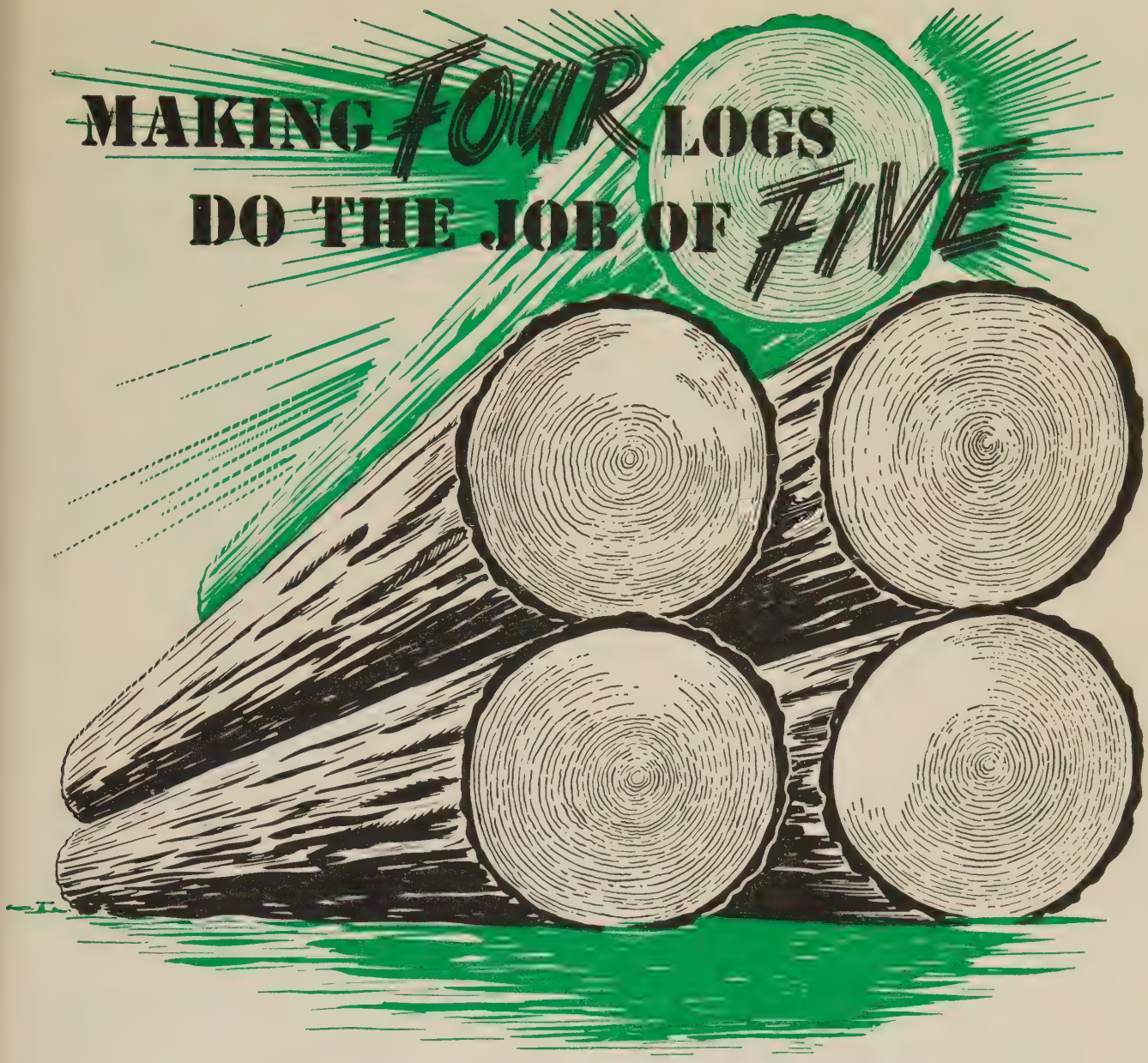
In summary of the present capital market, we find that loan capital is abundant and is cheap; common-share capital is relatively hard to get at a fair price. This makes it important for both borrowers and lenders to guard against the temptation of excessive borrowings for capital purposes.

FUNCTION OF TAPPI

Thus far you have noted a virtual complete lack of reference to TAPPI. Yet I am fully conscious that your group has an essential part to play, along with management, in maintaining our way of life, and this is becoming more of a struggle each day. It seems to me that your first responsibility is to reduce costs, which will in turn reduce selling prices and maintain volume. With rising prices all around us, paper prices generally have not been raised over a year ago. The index figure at the end of August, 1949 (lowest since May, 1947), was 195.1 as against 206.4 in the preliminary figure for August, 1950. During the same time the wholesale commodity price index had increased from 198.7 to 215.7. When you have been obliged to increase prices, it is my conviction that it has been done so only under the stern compulsion of mounting production costs. That is because you realize the policy of charging the lowest possible price in order to build the greatest possible volume of sales is the foundation stone upon which American business has erected an industrial economy that is the envy of every other nation. Obviously, profits cannot be overlooked, else the increased debt and increased plant account cannot be amortized, let alone a margin for further expansion. Profits are the keystone of our economy.

Recently Mr. Kettering, who is a name known to all of you, made a talk in Chicago in which a new element of profit was made known to me. His statement was something like this—it is well known that you have to sell your product for more than it costs you, or you go "busted." That difference goes by the nasty name of "profit." If the product you sell isn't worth a lot more to the customer than what he paid for it you will go broke too. That amount more that the article is worth to the customer than what he paid for it *is the customer's profit.* You will never see a reference to customer's profit on the financial pages—only manufacturer's profit. How do you find out what customer's profit is? Well, how much more is the electric light worth to you than you paid for it? How much more is your automobile worth to you than you paid for it? How much more is everything you have worth more than what you paid for it. That is your profit. It varies with different people at different times, yet it is the customer's profit or value over what is cost that built highways for enjoyment of the public, that put in the filling stations, that built buildings, that built great enterprises. In the final analysis, customer's profit—not manufacturer's profits—does the trick. That I believe TAPPI has largely done in the paper industry—that is why the paper industry has prospered.

MAKING FOUR LOGS DO THE JOB OF FIVE



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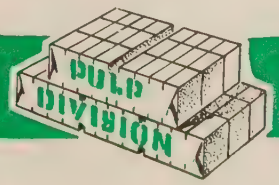

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INDUSTRY FUTURE

It has long been the established custom and a virtual requirement of a banker or economist to cast his eyes into the future in order to bring his comments to a conclusion. Accordingly, in an effort not to disappoint you, I am pleased to oblige in following the established formula by looking into the crystal ball which I long ago gave away to an itinerant swami to assist him in his prophesying. This doesn't bother me, since I know of no one who has successfully read the future with any commendable degree of infallibility. Whoever has my crystal ball at the present time has my sincerest sympathy.

I do know however, that, from what I read, the present volume of production is high and the profits in the paper industry, as reflected in the financial papers, are currently at a high level, which must be considerable comfort to management and the long-forgotten investor.

Current Problems

I agree with the following comments on the present situation made by Dr. L. T. Stevenson, Economist of the A.P.P.A. in a recent address.

"Statistically speaking, there is no shortage of pulp, paper, and board now, but try to tell that to a man who is trying to place orders for some of these products and he will nominate you promptly as a candidate for an asylum of some sort!

"Yet paper is being produced at an annual rate that will show an increase in production by 3 million tons more in 1950 than in 1949 or to an estimated $23^{3}/_{4}$ million tons of paper and paperboard. This is practically a 16% increase in one year! All of the data that I can gather indicate that ultimate consumption has not increased to the same extent. A reliable estimate places present consumption of domestically produced paper by ultimate consumers at not over 22 million tons annually. Add to this 5 million tons of imported newsprint and we will have 27 million tons against apparent consumption last year of less than 25 million tons and of 26 million tons in 1948, when it was more than clear that inventory was being built up. So why the shortage? To begin with, inventories of pulpwood and wood pulp were at a low level in July of 1950. Both commodities had suffered drops in price during the second quarter of 1949 when a number of forecasters felt that we were in for a 'real postwar shakeout.' Manufacturers did not rebuild inventories of their basic raw materials and the Sterling devaluation last fall caused them to continue the low inventory policy, even in the face of mounting production, because of price uncertainties. With the advancing commodity price level since January of 1950, the desire to rebuild inventories ran into a series of strikes at some pulp and chemical mills that prevented rebuilding the depleted pulp inventories.

"That was the situation when the Korean war startled the country into a fantastic buying spree. At paper mills the order backlogs jumped 64% from June to August, while production and shipments were of record proportions. August production surpassed any monthly production in history and July was the highest on record for that seasonally low month. September was a high-production month and I will be greatly surprised if October does not show another record. Capacity has been strained and yet inventories of raw materials have been maintained in spite of this record production. Capacity operation of paper and board mills will require sixteen million tons of wood pulp.

"So far, imports have been well maintained, possibly because, as reported by the trade papers, imported pulp contracts carry higher prices than most domestic contracts. The dollar is not quite as attractive in the foreign exchange market as it was a year ago. Barring strikes and hot wars there is no immediate prospect of a drop in imports until the Baltic freezes over. Even this may not cut the deliveries from that area, because the extremely high prices in terms of their domestic currencies would easily make it profitable to ship by rail to an open port.

"Domestic producers have settled strikes that curtailed and hampered production in the first half of the year. Substantial additional productive capacity has been brought in and the prospects are for an increase rather than a decrease in production over the next few months.

Government Requirements

"Our government is embarking on an increase in defense production for which the defense budget has been doubled and the personnel of the armed forces is to be doubled. How much paper and board is to be required for this activity?

"Based on 1944 production and consumption data when we were actively prosecuting a global war, consuming vast quantities of material, the amount required for *direct Government use* and by *defense plants* would be 5.6% of our present total paper and board production. As we were carrying one half of this burden last year, the increase might be 2.8% under all-out war conditions. Probably the increased consumption for both direct government and defense plants will be less than 2% of present production under 'cold war' conditions. This over-all 2% will have a varying impact on various uses and certain types of paper and paperboard will carry a much higher load than 2%. That will develop as the program develops. But overall the problem does not present a serious challenge to the civilian consumption of paper and board.

"Compared with 1943 production, this year's production of paper and board will be 39% greater, and 47% more wood pulp will be produced. Tonnagewise paper and board will exceed 1943 production by $6^{1}/_{2}$ million tons, and wood-pulp production will be over $4^{1}/_{2}$ million tons greater. These are enormous increases in tonnage for the short postwar period, and they merit the statement that the pulp, paper, and board industries have endeavored to anticipate and to meet their customers' demands. I fully believe that when this scare or inflationary buying eases we will find that paper is in good supply. In other words, scare buying has made the so-called 'sellers' market.' When the scare buying subsides to something like normal there will be an adequate supply of paper and paperboard."

Presented at a meeting of the Lake States Section of the Technical Association of the Pulp and Paper Industry, Green Bay, Wis., Nov. 14, 1950.

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A. E. BACHMANN

TAPPI, today, is rightly very proud of its testing methods, which from comparatively crude beginnings have attained international recognition as universal standards of scientific precision. The TAPPI Standards have possibly contributed more to the prestige and favorable recognition that TAPPI enjoys in scientific circles today than any other phase of its work. They have undoubtedly also been a truly important factor in gaining for TAPPI its large and distinguished membership of the present time.

The TAPPI Standards represent the composite thinking and work over many years of literally hundreds of paper technicians from all over the world functioning with members of our testing committees. Despite the risk of treating unjustly many others by singling out the contributions of any individuals, special mention for outstanding contribution to these standards is due to such people as B. M. Scribner and Helen U. Kiely in earlier years, and The Paper Institute staff, Roger Griffin, and General Chairman, J. d'A. Clark, in more recent years.

It is principally in the testing of their materials, products, and process variables that TAPPI members, as a whole, find a focal point of greatest common interest. We are all intensely interested in our testing methods because they essentially form the basic mechanism of our scientific approach to our many problems, whether of research, control, trouble shooting, quality improvement, or cost reduction. The contribution of our constantly improving testing procedures to these various functions over the years has been of outstanding importance.

It is not too long ago in our industry that most quality and process variables were controlled almost entirely by observation and judgment with a bare minimum through crude testing. It is also not too long ago that much paper was made largely according to ritualized formulas of furnish and by attempts at standardized machine settings of operational equipment. To deliberately use alternate materials or radically change operation condition standards for purposes of possible quality improvement or cost reduction was done only as a last resort, largely because of the lack of adequate testing procedures to properly safeguard the current standard quality of the product.

Through the use of improved testing methods we have been able to substitute testing to a large but not even yet fully complete degree for observation and judgment. To do this on the type of properties that require their use, we have had to devise tests which would give results that are in general agreement with our operating observations, judgment, and experience. When we can obtain such essential agreement we can then accept the test as being more reliable and selective than the constantly shifting product of our eyes and judgment. Through being enabled to measure, record, and correlate the results produced by material and process variables, we have also been enabled to improve general quality at a far more rapid rate in recent years.

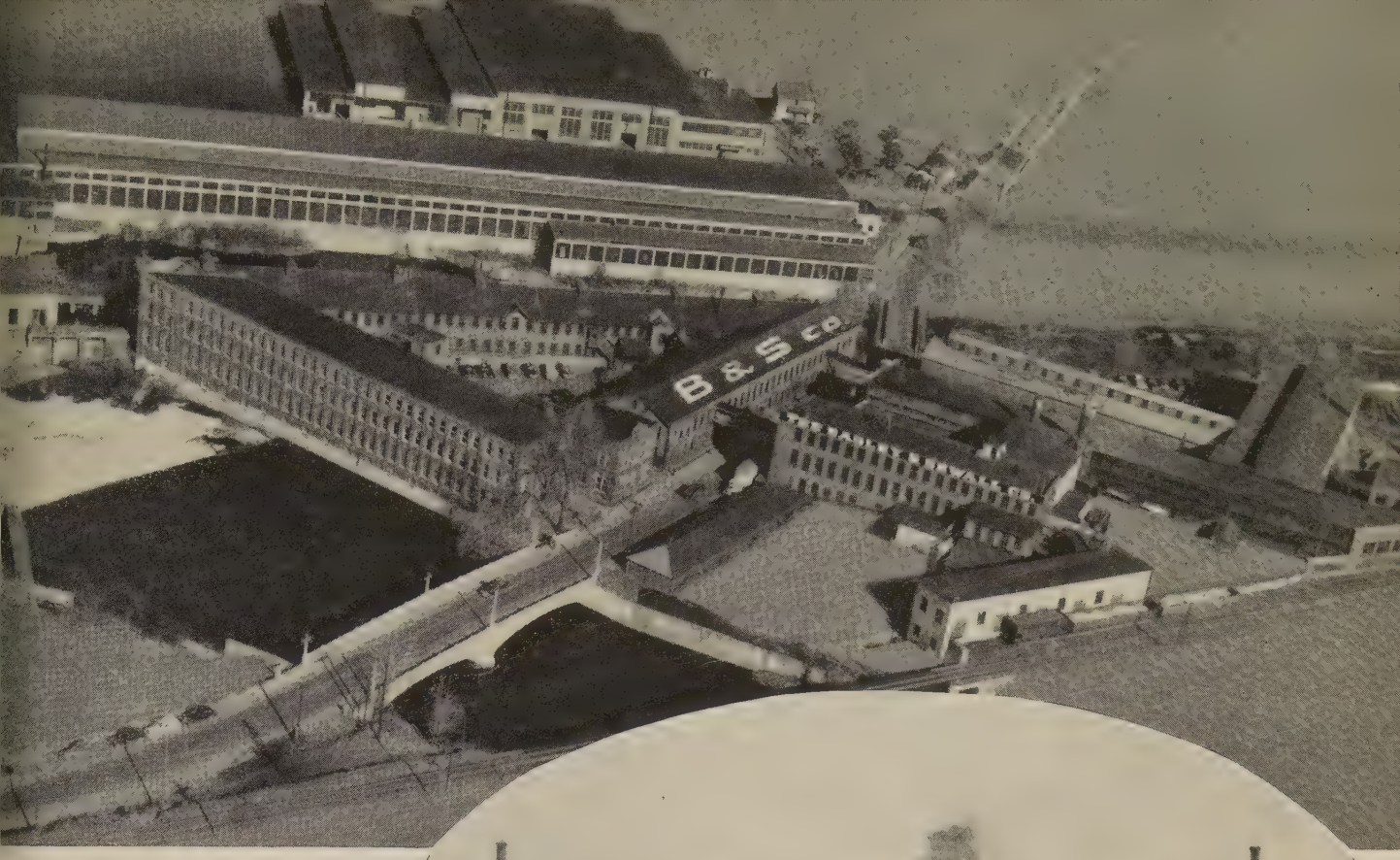
Improved testing procedures have also relieved us to a large, but not even yet fully complete degree, from the necessity for following traditional furnishes and process methods so closely. We have been enabled to operate more to standard tests rather than standard conditions of furnish and operation, without which, of course, all opportunities for cost reduction effects would remain unborn. To the extent that existing tests have relieved us from strict adherence to ritualized procedures we have been enabled, among other things, to increase speeds, use alternate materials, eliminate excess materials, and thereby to obtain cost reduction effects of considerable magnitude.

To cite only one example of the many types of benefits derived from improved testing procedures, through the use of the brightness tester we have been enabled to measure the relative effects of different bleaching agents and processes on our pulps. Its use has also enabled us to distinguish between brightness effects promoted by use of different pulps and clays, titanium and other types of fillers, water color, etc. Through its use also we have been enabled to distinguish, for example, the relative effects of furnish type, beating, titanium and thickness of liners on waxing grades of board. Very few papermakers would care to return to their old practice of attempting to discount the hues of whites in attempting to evaluate their relative brightnesses by eye alone. To many minds the development of the brightness test represents one of the most outstanding achievements in the testing field that exists today from the standpoint of general quality improvement, control, and cost reduction possibilities. This test has also undoubtedly contributed largely to two of the most outstanding practical research developments of the past 20 years, namely, the bleaching of kraft to high whites and the development of paper-machine coating.

Having now reached the position of some substantial degree of maturity with respect to testing, it might be advisable at this time to take stock of our position, to determine in what respects we may be incomplete or inadequate in order to direct our efforts toward these phases in making our future plans.

In general, our test methods, as a whole, are accepted as universal standards and are undoubtedly used as written by the research groups in the scientific world. These standards represent the fruits of much meticulous work. The philosophy of their development is to make them the ultimate in precision. They are often

A. E. Bachmann, President of TAPPI; Vice-President, Missisquoi Corp., Sheldon Springs, Vt.



1950

1905

Progress Over the Years

The picture in the oval shows the Bagley and Sewall Plant as it was in 1905. Although the acreage covered was not large, the paper machines made in this plant were considered top quality. We were the first machinery manufacturers to build a machine capable of producing paper at 1,000 lineal feet per minute.

Today our plant, housing engineering department, pattern shop, foundry, machine and erection shops, covers several city blocks. In it are the most modern, automatic machines that make possible the efficient manufacture of some of the largest and fastest paper machines in the world. Bagley and Sewall Machines are making tissue, bond, news, kraft, book, board in every section of the globe.

When you are ready to consider the addition of new paper machines or equipment, let us know. We'll gladly give you the benefit of our eighty years' experience.

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described as referee tests. They serve a valuable purpose as such even though they do not often figure in disputes as the description might imply. Aside from their use as research tests, we also need such tests of extreme precision to which other simpler, shorter tests, which may be developed for control purposes, can be referred as a sort of bench mark to judge their relative accuracy.

We have amply demonstrated above the use of our Standards for research and, in a general way, the inherent practical usefulness of the testing idea. Is our program, however, fully complete in conception for many other practical purposes, such as quality and process control, quality improvement, trouble shooting, capital equipment selection, and cost reduction in all its phases? Even at our relatively advanced status of today with respect to our standard testing methods and despite all the benefits received therefrom in the past, we must face the fact that for many practical considerations of our use requirements of paper, neither testing nor observation and judgment are complete of themselves. The one complements or supplements the other. We certainly have derived many benefits from testing but we still cannot get along entirely without observation and judgment of a high degree applied to our quality control. Testing corroborates what we see, observation and judgment corroborate our tests. Testing in many cases warns us in advance for what to look. Even indecisive and not entirely selective tests cause us at times to regard with suspicion something that we might otherwise overlook. There is much to do yet in producing more significant tests, such as the brightness test, in order to more completely minimize, if not to eliminate, the necessity for our using observation and judgment in our quality control.

For practical purposes tests must, above all, be useful in the eyes of people with pressing practical problems whose solution cannot await the more leisurely pace of fundamental research. In this connection I remember the words of a prominent scientist, who recently, in warning scientists against intellectual snobbery toward practical or applied research, stated: "There is nothing inherently evil or degrading about something being useful." We might apply such a criterion to some of our pulp and paper quality testing methods and investigate the extent that they are being used in practical fields. One extreme example of a test not being universally used as designed is, of course, the pulp strength test.

If we find that any of our tests are not universally used for practical as well as research purposes, the cause may well stem from any of several sources. The test may be unusable for practical purposes by reason of complexity of technique, by reason of involving the use of specialized equipment not readily available, or by the time required to follow its procedure strictly. The test may not have been sold sufficiently by reason of inadequate explanation in the form of papers regarding its purpose and practical usefulness, or by reason of too meager interpretation or lack of footnotes or appendixes describing pitfalls to avoid in obtaining the required accuracy. Also, it may well be possible that the test is not universally used by reason of the user simply rationalizing his recalcitrancy in not using the test as designed.

If we are ever to produce a common language for effective communication among ourselves it must be based on an alphabet of common tests and common test units. We should not talk a different language among various mills nor between operating and research departments within one organization. If we are ever to make a start to develop a set of papermaking principles, which can be universally adapted to the solution of specific operating problems and stop "playing by ear" or using "rule of thumb" procedures, we need such a language based on common tests and common units.

To what extent and by which means can our future testing program most effectively fit some of our practical as well as our theoretical needs? How can the supposedly conflicting interests of our heterogeneous group ranging from practical operators to research associates best be reconciled to produce such a common language?

One solution, of course, would be for TAPPI to recognize two individual tests, expressed in two sets of units, for some of our paper and pulp quality tests that require a long meticulous test procedure and involve the use of specialized equipment for extreme precision. At least two sets would be better than 200 which we might get if we did not accept a second as standard. Our testing committees might view their proposed testing procedures from two distinct standpoints. What is the most precise test that can be devised regardless of time or equipment or highly specialized testing techniques involved? Also, what would be the shortest, simplest test that can be devised that will give reasonably useful precision for control and practical research purposes? How much in precision and usefulness would be lost by using the shorter method of the two?

In this connection, after a long process of collection and editing, the TAPPI Routine Testing Methods are now in our hands. We commend these to the attention and study of our respective testing committees. While these methods are not dignified as TAPPI Standards, they are dignified by use in controlling millions of dollars of production daily. They are in many cases tests for specific properties not as yet included in our TAPPI Standards. Many of them are of a tentative nature and will be improved by their originators and other users in the light of further experience with them. All of us in production spend considerable time in the development of such tests to control specific qualities in our production. We sincerely hope that our testing committees will continue to work with them in an effort to improve and standardize them, and eventually adopt some of them as alternative or supplementary methods in appendix form to our regular standards as a means of encouraging the use of some standard methods to a greater degree than presently exists. Many of these tests may also form a working nucleus of many future additional TAPPI Standards.

The other alternative toward which our future testing program might be directed is that of encouraging the use, by all concerned, of our TAPPI Standards without alternate tests for practical purposes. To do this we need to examine specific tests with a view to their usability for these purposes with particular emphasis being placed on explaining in the form of footnotes and appendixes the purpose of the test, including methods of interpretation. For these purposes we need to eliminate

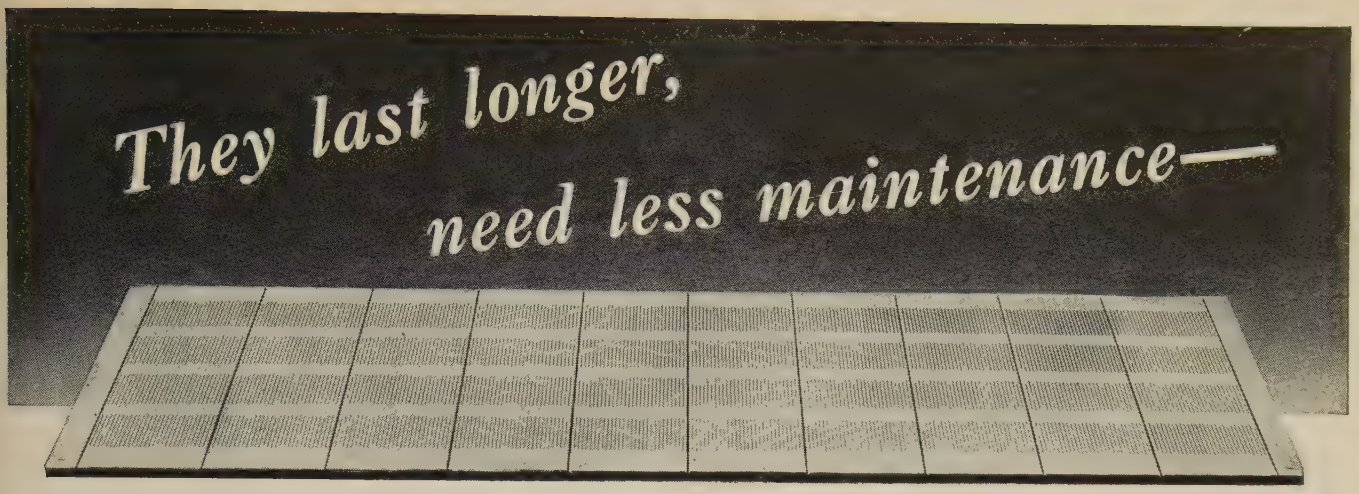

Photo courtesy Magnus Metal Corporation, Fitchburg, Mass.

INCONEL screen plates by MAGNUS

Nearly eight years ago, a Canadian mill decided to see if they could get longer service life from screen plates. Up to that time, the best screen plates tried had failed through corrosion or fatigue, after only about a year of service.

Then, in 1943, they tried screen plates of Inconel®. Today – *nearly eight years later* – these Inconel plates look as good as new.

This long plate life can be credited to two outstanding characteristics of Inconel – exceptional resistance to fatigue and corrosion by mill stocks.

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For further information about Inconel screen plates, write directly to Magnus Metal Corporation, Fitchburg, Mass.

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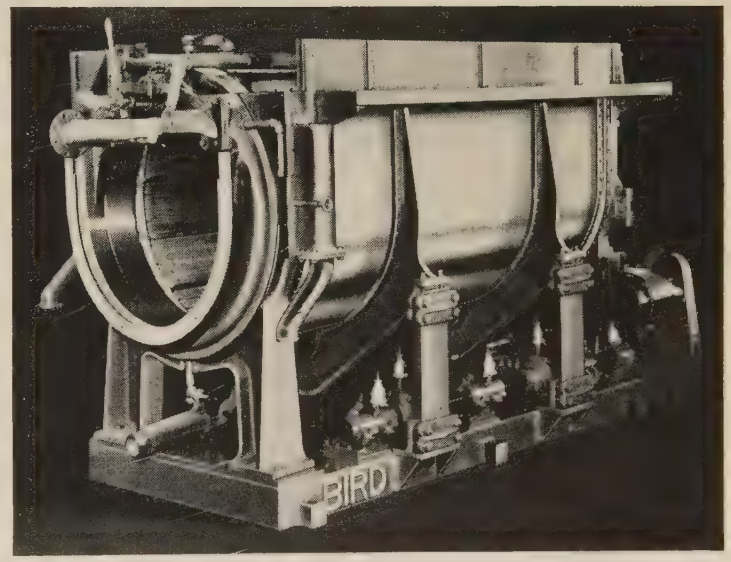

Inconel screen plates in position on a Bird machine. Photo courtesy Bird Machine Co., South Walpole, Mass.

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any undue meticulosity as well as to minimize the use of specialized equipment and techniques which may or may not reflect considerably greater precision. We need also to do a better selling job in persuading people to use them for all purposes by writing papers of explanation and pointing out pitfalls incurred by short cuts. We need studies of relative reproducibilities, in terms of their effective working ranges for practical purposes, of our Standards and any shorter, simpler methods. We need, in short, to convince people that by using any short cut they really miss something of practical significance.

Our attention thus far has been directed largely to the problem of whether our standard tests are being fully used and to the problem confronting us in making them more universally usable. If we are ever to develop, even to any small extent, an understanding of the fundamental principles of papermaking, a basic necessity is the development of a common language for comparing our respective experiences and data in the form of common testing methods and common units. There exists, however, still another problem in this connection that we must face. That is the problem of why we ourselves do not use for all purposes standard methods as outlined but persist in taking short cuts, often to our subsequent sorrow. We all have various excuses for rationalizing such actions; namely, that some of the tests are too long and complicated, that we have data extending over a period of years on a different basis of testing which we do not want to lose for comparative purposes, that the units are unfamiliar to us, or that we do not possess the necessary testing equipment.

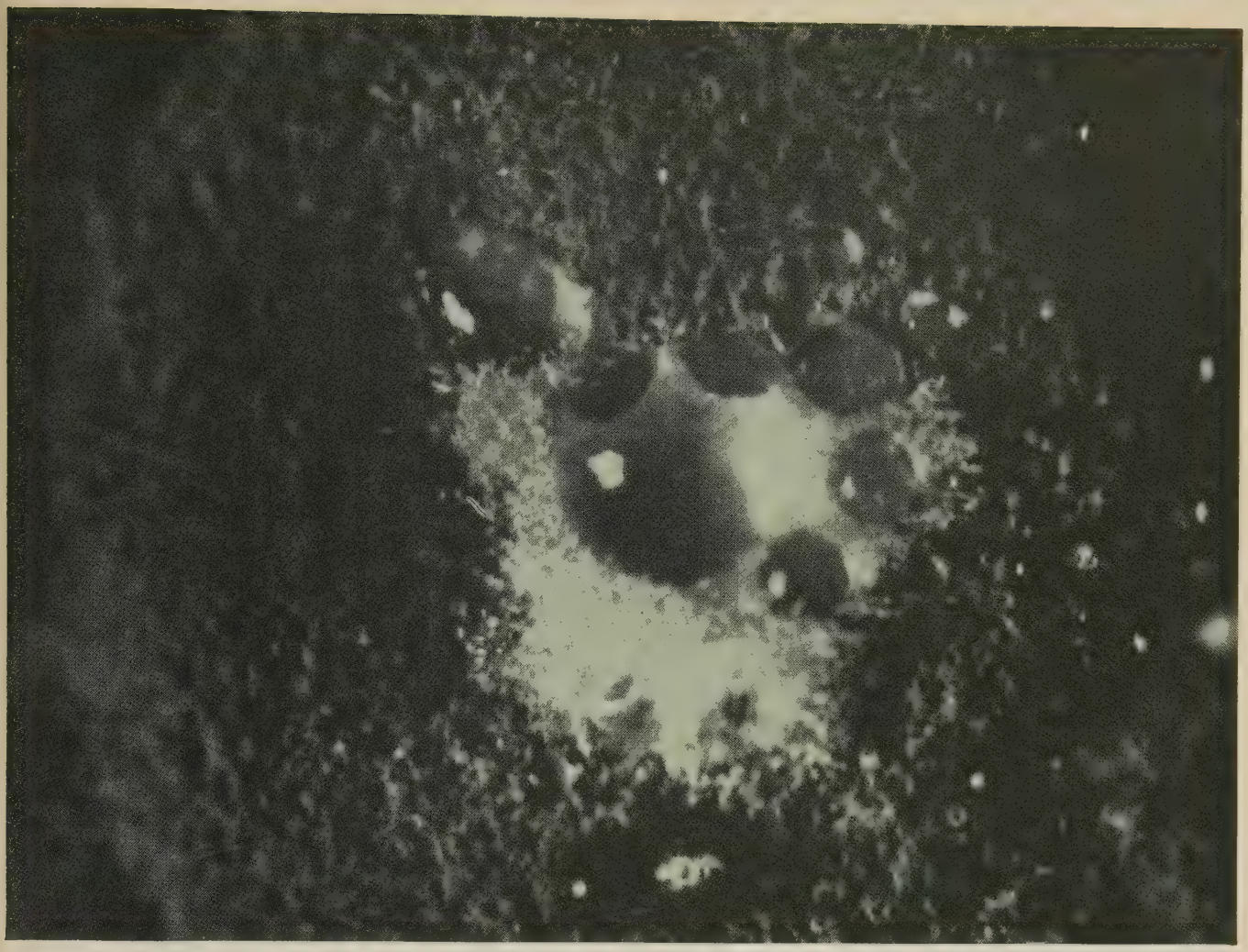
If we really desire to cooperate in gaining more knowledge of the principles of our industry, our testing committees and the prospective users of tests must both examine their respective positions more carefully. Our testing committees might examine the extent to which the tests are universally used, and if not, why not. The potential users of the tests should examine more carefully the validity of their implied criticism of possible overmeticulosity on the part of the testing committees.

If they find tests are not being universally used by reason of their being too long or complicated, the committees might consider alternative tests as outlined above or indicate more clearly the reasons for specific items of procedure and indicate the degrees of reproducibility, accuracy, or pitfalls occurring with short cuts. If reasons of preserving continuity of data prevail, we as individual users might try extracting the principles involved out of our old data. If these are not clearly evident, no harm is incurred by abandoning such data and taking a fresh start on a better basis. Alternatively, we might run the standard test concurrently until a correlation is obtained between the new and old data, or conviction regarding the improvement of the new method occurs, and familiarity with the new units of measurement prevails. If it is a question of spending a few hundred or a few thousand dollars for new testing equipment, this can be done gradually, and it is sure to bring its cost back many fold in improved control facilities and enhanced knowledge and understanding of the data in the literature. One of the marks of good management is the intelligent spending of money on fixed costs to bring back improved results in the form of general cost decrease. The purchase of adequate testing equipment and use of good testing methods affords one of the greatest opportunities for cost decreases of all kinds, while affecting the break-even point by what surely would be a purely negligible amount.

None of the above objections to using the standard methods will really hold water provided that we all cooperate. To cooperate, we, as designers of tests, must be careful not to attempt to impose our viewpoints regarding what is right on all prospective users. There should be selling explanations and reproducibility data by which to produce a real conviction that it would be stupidly unscientific not to use the standard method. To cooperate, we, as users, must also be equally careful not to be guilty of rationalizing or not, using the standard tests for the several reasons outlined above—losing existing data of possibly doubtful value, lack of time for exacting tests, lack of specific testing equipment, and often also, of simply following the path of least resistance.

If we are to cooperate in the interests of developing a more common testing language, more specifically how should we proceed to do this? In the face of considerable diversity of viewpoint, interests, and thinking habits, any two people or groups, not being completely familiar with the other person's problems and consequently feeling that they are definitely right, naturally intend for their own ideas to prevail. If they are to cooperate from such a position it would seem in order for each to prove and attempt to sell or teach their position in the matter to the other to the best of their ability. Each must remain exceedingly receptive, open minded, and sympathetic with the ideas and position of the other. Each should attempt to imagine himself in the position of the other, with the other's responsibilities, and the other's devotion to scientific integrity. Next, the one to whom it means the least in terms of principle or practical usefulness sacrificed, according to their respective viewpoints, must yield in order to reach any common viewpoint. If we have any great desire to profit to the fullest extent possible through the benefits of a universal language of common tests and units, we all need, at times, to do more yielding. On the one hand, we also need to give more thought to making our testing methods more universally usable and, on the other hand, all of us need to use them as finally designed without reservation of any kind.

If we succeed in developing a universally used language of common tests, common units, and the proper interpretation of them in terms of specific paper quality properties, we shall then have the basis for a start toward the next important step, namely, the formulation of general papermaking principles. Such a set of principles would eventually enable us to discard the shackles of some of our nebulous trial and error attempts at progress and held immeasurably to advance the rate of progress of the industry. To a very large extent the rate of such progress depends on how well our TAPPI committees accept the challenge to produce continuously, in ever increasing quantities, new and improved usable methods for testing our materials and products, and how well we, as individuals, make effective use of them as designed.



Aspergillus from growth on paper magnified 78X.

Beat the "Bugs" to the Draw!

Now you can ward off costly attacks of bacteria and mold *before* these microorganisms become numerous enough to cause production losses and wasted materials. You can keep them out of lap stock and prevent discoloration and loss of pulp which they often cause.

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Developments in the Graphic Arts—1949–1950

ROBERT H. SIMMONS

In writing the developments for 1949–1950, there are included a number of items which have recently been reported in the trade magazines. Some of these items were developed before the time period noted in the title. These, however, may be pertinent to some subject written into this issue.

PAPER

Pulp from straw and bagasse are back in the news as a papermaking fiber. E. R. Timlowski of the Kinsley Chemical Co. has introduced a new method for the production of pulp from straw and bagasse. It is reported that this method gives a 60% yield of raw pulp with a 50% yield of bleached pulp. The fiber is long, strong; and good for book papers. A trial run was made by the Chemical Paper Co., and an 8-page, section of the *Daily Transcript-Telegraph* of Holyoke, Mass., was run Jan. 26, 1950.

The S. D. Warren Co. have reported a "New Principle in Lithographic Paper Manufacturing," a coated paper surface which is absorbent to ink but nonabsorbent to water. This paper gives high-quality reproduction, brilliant halftones with clear precise dot formation, smooth solids, and opaque ink film. Press operations show that the paper can be run at 6000 impressions per hour without offset and with full color. Because of the resistance to water, there is no paper curl at the delivery.

Robert D. Erickson has an ion exchange method for producing a coated paper. The adhesive is hydroxy alkyl cellulose which is used with the pigment and a dilute solution of sodium hydroxide. The coating mixture can be applied by any known method. The coating is then sprayed with a solution of ammonium sulphate which precipitates the hydroxy alkyl cellulose. The sheet is passed between squeeze rolls to remove excess water and dried. The resultant finish does not require calendering and is suitable as paper machine coating for letterpress or offset printing. The paper has a high brightness, opacity, ink receptivity, and ink adhesion. The coating has a good compressibility which reduces the make-ready required to give good impressions. The coating is oil, grease, and solventproof.

Dow Chemical Co. have developed Dow 512X with the properties required to make a latex suitable for paper coating. It can be used in wallpaper and wall board and conventional coated paper. It gives a pigment-coated paper which can be printed by all printing processes with standard inks.

The Hobart Paper Co. (Chicago) offer "Repello Board" treated with a waterproofing agent which is introduced in the early stages of processing making it an integral part of the board and not a surface treatment. The method provides a whiter, more repellent board at a lower price. It has a finish offering the finest reproduction qualities.

There are a number of places in the graphic arts where the maximum in dimensional stability of paper is required. Alex J. Bart, in the *Photo-Engravers Bulletin* (*1*) tells how to mount dry photographic paper on glass or tinned metal by scouring with pumice, coating with bookbinder's flexible glue, and allowing it to become tacky. The paper is then rolled on and allowed to dry. The mounts will stand photographic processing, but will release with soaking in hot water.

The *Printing Equipment Engineer* has reported several paper-handling machines. The Starstarter (*2*) is a machine which counts the number of newspapers at the delivery end of the press, and conveys them to the wrapping table at the same time feeding a sheet of wrapping paper from a roll under the pile. This prevents smuding of the ink by the tapes, and puts the wrapper in position to permit immediate wrapping. By means of air jets and counter balances, the wrapper is fed under the pile, cut from the roll, and the tapes stopped when the pile reaches the wrapping table. The Counter and Control Corp. have a machine (*3*) which automatically counts and inserts a tab. At the end of a count, a switch actuates the tab-inserting machine and resets the counter. The machine is said to operate indefinitely.

The Cooksey Web Break Detector and Web Severing System (*4*) is mounted just ahead of the impression cylinder. It detects a web break and, by means of solenoid operated drop rollers, snatches the other part of the severed web out of the unit. This prevents the paper wrapping around the cylinder, eliminating battered plates, misregister, and upsetting the ink setting.

Orville Dutro & Son (*5*) have a machine called the Colorverter which will slit and rewind roll paper at the same time, coloring both sides of the paper in the same color or each side with a different color. A printer need carry only white paper in stock. Dropped rolls can also be salvaged. The machine is advantageous for form printers, paper boxmakers, tag printers, envelope manufacturers, and paper converters. It will produce a full range of colors as well as brilliant and metallic colors.

The Carbon Web Corp. (Cincinnati) produce a pro-backed one-time carbon paper which is guaranteed not to curl under changes of humidity and temperature. The paper has been tested in most operations under freezing and tropical temperatures.

INKS

British Standard 1480-1949 sets standard colors of hue strength, and light fastness for three and four-color inks for letterpress. There is a darker blue standard for three-color work. Potential savings in time and production costs are clearly evident. Complete collaboration by all concerned is necessary in order to make these standards work. A set of charts showing the range of hues and tones reproducible with the standard inks, including a key to the dot size required to obtain each color, is included in the Penrose Annual 1950.

United States pat. 2,439,443 (April 13, 1948) is a process for making a hydrophilic carbon black by combining a granular carbon black with sodium hypochlorite in proportion of about 100 grams black to 300 ml. water and 300 ml. of a 10% sodium hypochlorite until exothermic reaction takes place thereby forming a sludge of 8 to 9 pH. The sludge is acidified to bring its pH to about 2.0. Filter the sludge and wash until the black begins to disperse in the wash water and partially dry at a temperature not substantially over 100°C.

Switzer Brothers Co. (Cleveland) have added an orange and red to their line of fluorescent colors for printing inks. They are used for signs, posters, and other displays, making outdoor advertising media visible four times the distance of normal colors, and are marketed under the name of "Neon in Print."

Australian Dry Colours Printing, Ltd. have developed zinc-chrome colors which are said to be nonpoisonous, possess low specific gravity, and are lightfast. Minnesota Mining & Manufacturing Co. have a chromium oxide and chromium oxide green (P-0245) of very high purity. E. I. du Pont de Nemours have a new yellow pigment which does not bleed in most solvents.

German pat. 735,912 is for a drier of the xanthate type. Xanthate is used as a solubilizer radical. A suitable metal solution is precipitated with potassium acid xanthate which permits the recovery of crystalline metal xanthate which can be easily purified. The xanthates have good solubility in oils and solvents.

Robert H. Simmons, Government Printing Office, Washington, D. C.

STREAM POLLUTION ABATEMENT?
FIBRE RECOVERY?

Check the CYCLATOR®

Here's what we've done at the River Raisin Paper Company plant in Monroe, Michigan. A CYCLATOR is treating white water from two cylinder machines producing liner board. B.O.D. reduction averages 52.4%!* Suspended solids are reduced 99.0%!* In addition to these positive stream pollution abatement steps, fibre losses have been reduced to 0.1%* by reusing the underflow which has a consistency as high as 2.5%.* The value of the recovered fibres defrays a high percentage of the operating costs. If white water, stream pollution abatement and fibre recovery are among *your* problems, put them up to INFILCO! Send today for our Bulletins No. W850, 23-409, and other pertinent data.

A FEW INFILCO WHITE WATER TREATMENT PLANTS

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CONTINENTAL DIAMOND FIBRE CO.	Bridgeport, Pa.
FEDERAL PAPER BOARD CO.	Reading, Pa.
W. C. HAMILTON & SONS CO.	Miquon, Pa.
NEW YORK & PENNSYLVANIA CO.	Johnsonburg, Pa.
RIVER RAISIN PAPER CO.	Monroe, Mich.
TAYLOR FIBRE CO.	Betzwood, Pa.
AMERICAN DEFIBRATOR CO.	Mexico City, Mex.

**Michigan Stream Control Commission Report, March, 1949*

INFILCO

• BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894 •

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SALES OFFICES IN TWENTY SIX PRINCIPAL CITIES

WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT

Perfumed inks have again found favor. An advertisement to illustrate the fragrance of "Muguet des Bois" (Coty, Inc.) was perfumed in an issue of the *Long Island Daily Press*. The *Chicago Sunday Tribune* featured the odor of "Dial" soap in an advertisement of this soap. An insert of the *Tribune* was printed with regular news ink on cloth which advised housewives to rinse in warm water to obtain a clean, new dust cloth.

Meta-Paste Products, Inc. (St. Louis) are marketing aluminum and gold pastes which are nontarnishing and nondiscoloring for use in printing ink formulations. Tests have shown that the paste will not harden or oxidize, and with oils and solvents will form an elastic, nonchipping coating which is resistant to acids, alkalies, and water.

Neehi Protective Coatings, Inc., have a marking ink designed for use with automatic and manual marking devices with rubber or steel type. The ink is fast drying and can be regulated to suit marking conditions requiring waterproof, weatherproof, fade resistance, and acid or alkali resistance. United States pat. 2,435,222 (Feb. 3, 1948), assigned to Western Union Telegraph Co., is for a fluid marking ink consisting substantially or entirely of glyceryl monoricinoleate and dissolved dye.

A Liquid Proving Ink (*6*) eliminates a daily wash-up, dries very slowly on the press, and very quickly on the paper.

International Printing Ink Corp. have a wet-ink varnish "Elixirin" and new metal decorating inks. They make possible the wet-ink varnishing of prints which formerly had to be dry varnished. These varnishes eliminate some of the common faults of bleeding, embossing, haloing, crawling, and other disorders.

Andries Voet has assigned U. S. pat. 2,450,534 (Oct. 5, 1948) to J. M. Huber Corp. for an emulsion printing ink. A stable dispersion of a vehicle insoluble pigment in a vehicle composed essentially of a water emulsion in water-immiscible ink vehicle liquid with a long chain nonaromatic amine containing a linear hydrocarbon chain of at least 15 carbon atoms and having at least 18 carbon atoms attached to a nitrogen atom through carbon bonds.

A liquid printing ink is described in U. S. pat. 2,449,230 (Sept. 14, 1948) which consists of a coloring matter and binder dispersed in a hydrophilic liquid carrier containing water, the predominant constituent of said binder being a lignin from fiber liberation. The lignin can be fused with a thermoplastic resin, i.e., rosin, ester gum, dammar-alkyd type resin modified by chemical combination with natural resin acids. The liquid carriers are organic compounds which exert a solvating action upon the lignin.

The American Resinous Chemicals Corp. specialize in ink toppings for vinyl films, such as rotogravure and silk screen inks for printing on vinyl surfaces. William Heinecke, U. S. pat. 2,450,959 (Oct. 12, 1948), has a silk screen printing ink consisting of a mixture of the reaction products of shellac, diethanol amine dissolved in isopropyl alcohol, and octyl alcohol with bentonite and carbon black. The ink is said to be nonwarping on paper and removable from the silk screen by a water wash.

The International Printing Ink Corp., working in conjunction with the Celanese Corp., have an ink for letterpress printing on acetate film which permits plate polishing. The ink will not lift during polishing, eliminating the need to laminate over the printing.

Dupax Products Co. (San Francisco) are packaging printing inks in $^1/_2$ and 1-pound pliofilm bags to prevent drying of the ink.

COLOR

The Harold M. Pitman Co. is handling a process of color separation by the use of fluorescent materials. The use of fluorescent materials is not new, but the Kemart method of exposure is claimed to be a new method of making the color separations. The highlight exposure is made using a special purple emitting camera lamp, then exposure is made to the regular camera lamps to give detail. In order to work in highlights, the retoucher may use Kemart Highlight White or Densitone on the original or by masking. A special artist's lamp, which gives off light similar in spectral nature to that emitted by the Kemart Camera Lamps, can be used to check the degree and location of the fluorescent materials.

The General Aniline Librascope Tristimulus Integrator has been designed for use with the Hardy General Electric Spectrophotometer. It analyzes the reading of the Spectrophotometer, correcting it for wavelength response of the average eye, to give three numbers, known as tristimulus, which are unique specifications of the color of the sample. The calculations require only $2^1/_2$ minutes.

A. M. Rookyard (Quebec, Canada) has developed a Chromometer which reproduces color similar to those produced by printing inks. By turning dials for the desired percentages of red, blue, yellow, and black and pressing a light button, the final color produced by that combination of the primary colors can be predetermined. The device will mathematically give 14,640 shades.

Instruments (March, 1950) reports an extremely sensitive Color Comparator called "Color-Eye." It is said to be five times more sensitive than the human eye and measures tristimulus values relative to white on a percentage scale and will take samples of $^1/_2$ inch width up.

G. Stuart Braznell (*7*) has reported the use of the Photovolt Photoelectric Reflection Meter in the control of printing ink flow. The ink flow is standardized by weighing a standard amount of ink and using it to run ten press proofs. The color is measured using the Reflection Meter on a print which is nearest to practical ink flow. Color filters must be used in measuring each color. To take measurements it is necessary to have an area of solid color $^1/_2$ inch in diameter. By the use of this instrument, it is possible to maintain absolute control of the color, not only on one press, but from press to press. The instrument is equipped with gloss attachments which make it useful in testing varnished inks or changes from flat to gloss inks. It is very good in helping control color on the night shift.

Albert W. Gray, in the *American Printer* for November, 1949, reports that legibility of printing involves two factors, color and brightness. Each plays an almost identical role. A rule evolved at the University of Minnesota in relation of legibility to color is "the greater the brightness difference between symbol and background, the greater the legibility of the print." The article lists the rating of "color combinations and their visual effects."

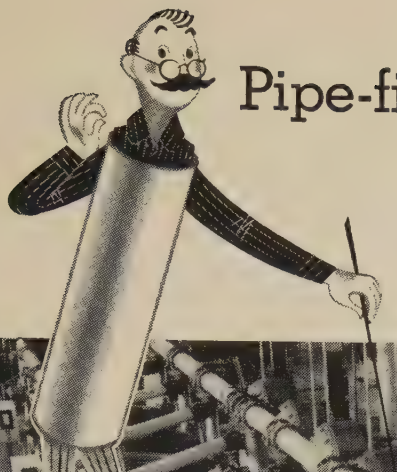
An electronic color scanner corrects color separations from transparencies. The device employs a scanning beam which passes through the transparency point by point and is split up by the three separation filters and directed to three photocells. The resulting current passes through electronic circuits which perform the color correction and then operate glow lamps to expose the separation negatives (*8*).

PHOTOGRAPHIC ILLUMINATION

There have been a number of high-intensity lamps or lights developed for photography. The Photo Research Corp. (San Fernando, Calif.) have "Spectra," a direct reading color-temperature meter which eliminates a common cause of bad results in color photography by eliminating guesswork in determining color light (on standard color-temperature scale). It embodies a photocell and direct-deflection indicator, thus obviating the need of peering through colored-glass wedges. The range is 2000 to 30,000°K. (from candlelight to most intense blue sky).

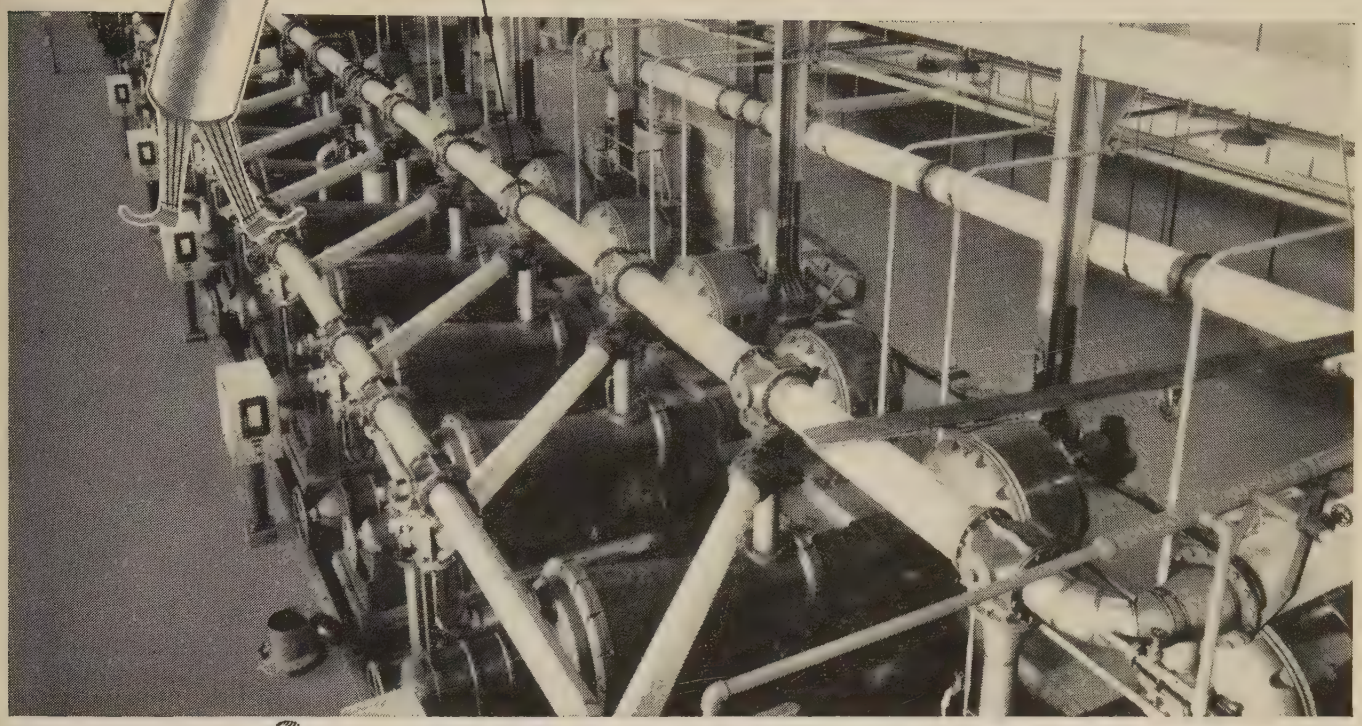
The Microtonics Corp. (New York) have a rotating turret with filtered light for making color separations. Separations are made without the use of arc-lights or filters on the camera. A turret contains four batteries of different color lights which are said to emit exactly the desired light for color separations.

J. N. Aldington reported to the Illuminating Engineers



Pipe-fitter Pete says:

"For process lines that stay cleaner longer...



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If you're looking for process lines that won't discolor paper stock . . . and require only a minimum of attention for cleaning or maintenance . . . Transite Pipe may be the practical answer to your problem.

Like many leading paper mill operators, you'll probably find that Transite Pipe is money-saving insurance against these production problems—and for three good reasons:

It resists corrosion—Made of asbestos and cement by a special Johns-Manville process, Transite is a dense, non-metallic pipe that combats corrosion. It has exceptional resistance to such chemical agents as mild alkalis and acids that often cause deterioration in other pipe materials. Moreover, because Transite cannot rust, it protects paper stock from discoloration.

It reduces sliming—Service records in leading paper mills show that Transite Pipe stays cleaner longer. Its unusual ability to resist sliming reduces shutdowns for cleaning—means a minimum of pipe line maintenance.

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Complete Transite Pipe systems, including couplings and Streed Transite Lined Fittings, are available for stock, washed pulp, white water, and other process and water lines. For further information, write Johns-Manville, Box 290, New York 16, N. Y.

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Society of London on a xenon-filled discharge tube operated under conditions which cause it to emit a radiation of sunlight quality. The radiation is characterized by an intense continuum extending from the ultraviolet through the visible region into the infrared.

The Grafarc (The Strong Electric Corp., Toledo, Ohio) have a new lamp which delivers approximately twice as much illumination and therefore cuts printing time on the larger printing frames. The lamp has 140-ampere arc current, draws 35 amperes from 230 volt a.-c. line, has precision carbon feed motors, silvered glass reflector, and is shielded from drafts.

The Western Union Telegraph Co. have the "Telcoarc" which radiates a light one eighth as bright as the sun. It operates in the open air from a pool of molten zirconium metal. The electrodes are only 0.2 of an inch in diameter, but have several hundred hours of life, are free from toxic fumes and a large amount of combustion products, and are extremely stable with continuous spectral energy distribution and color temperature at 3600°K.

The Huggins Laboratories of Menlo Park, Calif., have a high intensity mercury arc lamp of 90,000 candles per sq. cm. at 1.2 amperes and 1750 volts.

The Gelb Vacuum Printing Frame has a mercury tube lamp which travels from edge to edge across the flat of the frame, furnishing an even intensity across the frame. The light is of high intensity and requires only 8 amperes to operate. The exposure time is only one half of the conventional 35-ampere arc.

AIR CONDITIONING

Walton Laboratories have a new, Model 30 Humidifier. It requires no compressor or drain; just attach to the local water supply. It evaporates 3 gallons of water per hour.

The Ebco Manufacturing Co. has the Oasis Air Drier which will dehumidify a closed area of 8000 cubic feet or less. It operates on a $^1/_6$-hp. motor and removes 3 gallons of moisture from the air every 24 hours.

The Weston Electrical Instrument Corp. have a small motor-operated fan for attaching to a relative humidity instrument to take readings in small confined spaces. Readings can be obtained in 30 seconds and read on a slide rule. The same company has a small pocket Humidicator which has wet- and dry-bulb thermometers and a built-in slide rule calculator.

DRYING AND STATIC ELIMINATORS

The Unetron Electric Dryer (*9*) is a radiant ink drier adapted for web and sheet-fed presses. It has variable heat controls which can cut off or produce heat immediately. The drier will not explode or backfire, dries without scorching, giving better ink and paper finish, and will not burn or cause web break.

United States pat. 2,379,913 (1947) is for an automatic infrared drying device of the open glow-coil type which extends across the sheet at a suitable distance and is retractable. Charles C. Dayles is the inventor.

Parallel-spaced electric fields, unaccompanied by a corona discharge between spaced pairs of electrodes connected to a source of high-frequency alternating current, as a means of drying sheet materials, is the subject of U. S. pat. 2,459,622 (Jan. 18, 1949) assigned to Wallace P. Cohoe and Mitchell Wilson.

Paul J. Hartsuch reported on the use of radioisotopes for determining residual chemicals left on the surface of lithographic plates.

The Chapman Electric Neutralizer Co. has a new low-voltage static eliminator which can be installed on machines where space limitations make it impractical to install the high-voltage eliminator. The new eliminator is an individual type without external high-tension wiring.

The Alphatron Static Eliminator is polonium electrically deposited on nickel. Polonium is a pure alpha particle emitter. The alpha particles ionize the surrounding air and dissipate static. There is no hazard radiation since the alpha particles are converted into helium on passing through 4 cm. of air and will penetrate only a few microns of skin. No deterioration of alpha particles occurs with age.

The Omegatron Brush has a strip of polonium on the ferule of a 3-inch camel's-hair brush neutralizing the static charge which holds dust and lint, to permit easy removal.

The U. S. Radium Corp. have static eliminators called Ionotron Bars. There are no electric wires or current. Each bar is shielded and supports a strip of radioactive source which acts as a conductor and draws off the static charges as fast as they are generated.

An article, "Radioactive Static Eliminators," *American Pressman* 60, 4: 36 (March,1950), advises on the potential industrial hazard of these static eliminators. The article states that alpha, beta, and gamma rays are emitted. The alpha rays ionize air for a radius of 3 inches and a sheet of paper is sufficient protection. The beta rays are active through several meters of air and require $^1/_8$ inch of steel for protection. No amount of shielding will completely protect from the gamma rays.

PRINTING PRESSES

Vandercook & Co. have a proof press with an adjustable bed for proving plates of varying thickness.

There is a new ATF-Klingrose rotogravure cylinder proof press available for preprinting proofs and checking engraved cylinders for corrections without mounting them on the production presses.

Wellington J. Smith (Cleveland) has the Wellsmith Press, a small hand-operated cylinder press which is self-feeding and self-inking. It prints a maximum surface of $8^1/_2$ by 11 inches on a paper size of 9 by $12^1/_2$ inches at about 2000 impressions per hour.

The Goss Printing Press Co. have British pat. 604,012 for a method of printing electrically, transferring the ink from the carrier to the sheet by developing an electrical potential. The printing mechanism includes an electrically conductive rubber surface.

The Inta-Roto Machine Co. (Richmond, Va.) have a press which prints in multicolor rotogravure on cellophane, acetate, paper, or foil and laminates it to another web in one operation. After leaving the press section, the web is coated with an adhesive and then laminated to another web. The press can print or laminate separately and is good for short runs by rotogravure at low costs. The web can be rewound or sheeted.

The new Thrissell Gravure Press (English) also prints foils. It is designed to have the shortest paper line with a maximum drying effect and a minimum of heat. The press has enclosed printing ducts and strong press units to insure sufficient pressure for printing solids on rough-faced materials as well as films and foils. It operates easily with quick change-overs for dealing with comparatively short runs.

The Robert Gair Co. have installed sheet-fed gravure presses for printing directly on paperboard. High-quality gravure impressions are obtained at speeds of 3000 to 6000 per hour.

The Champlain Co. have designed an aniline press for board converters and package printers which will deliver printed, die-cut, scored, and stripped cartons up to 600 f.p.m. The roll-fed web can be printed on one or both sides in any number of colors and varnished in the same operation. When plate changes are necessary, only the printing cylinder need be removed. Automatic electronic register control may be added.

The Hudson-Sharp Machine Co. have designed an aniline rotary press which is web fed and can print in aniline, letterpress, or gravure. It is built in stack design from one to six colors with each color complete with fountain and tympan roll. Numbering, perforating, and slitting may be in-

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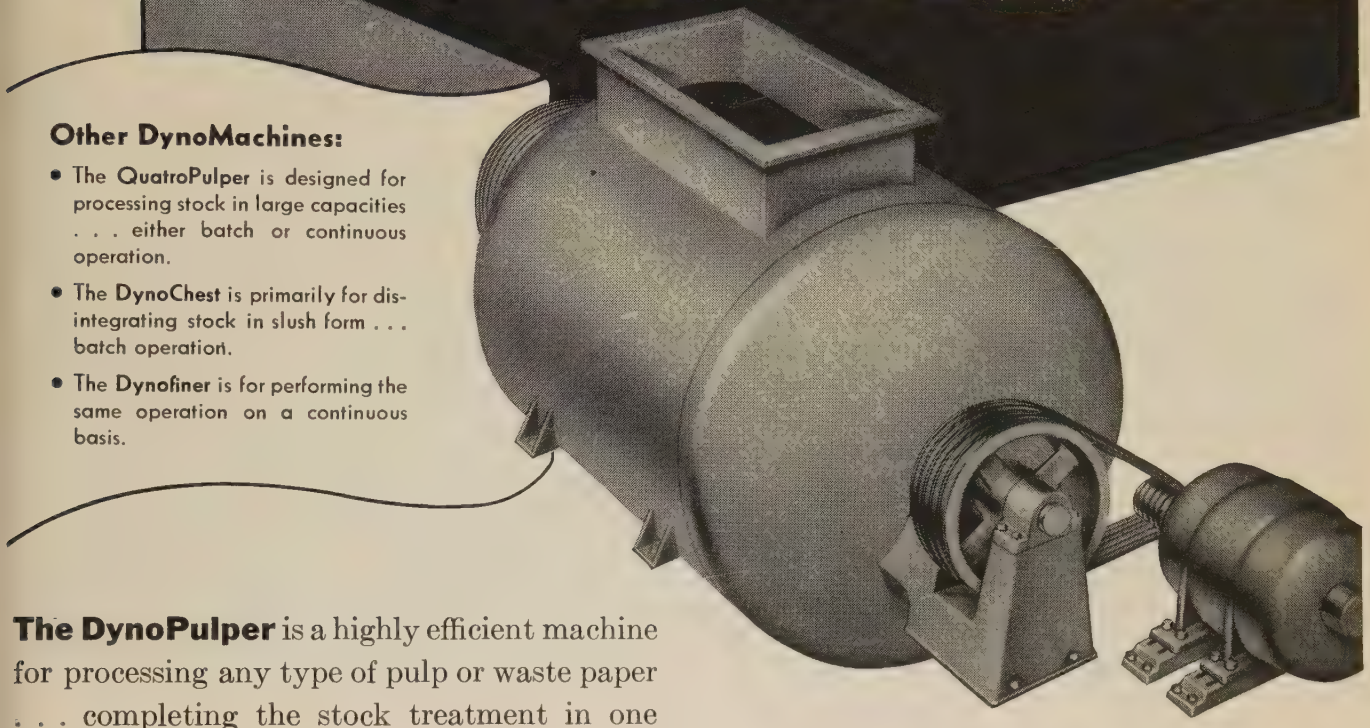
* U.S. PAT. Nos. 2,516,632,—2,516,633,—2,516,634

The Rice Barton DynoPulper

—completes treatment of paper stock in one machine



Other DynoMachines:

- The **QuatroPulper** is designed for processing stock in large capacities . . . either batch or continuous operation.
- The **DynoChest** is primarily for disintegrating stock in slush form . . . batch operation.
- The **Dynofiner** is for performing the same operation on a continuous basis.

The DynoPulper is a highly efficient machine for processing any type of pulp or waste paper . . . completing the stock treatment in one operation.

The DynoPulper employs two opposed DynoPellers (described below) which rapidly and economically reduce the stock to slush form . . . then continue the operation to completely separate the individual fibres one from the other. There is no appreciable drop in freeness and no cutting or shortening the original fibre.

The fibre characteristics of the stock can be developed further by giving it additional time in the DynoPulper . . . eliminating the need for beating on many grades of paper.

RBR-9

The DynoPeller
is the heart of all DynoMachines. Its concave face is lined with rough, hard carbide particles. As the DynoPeller rotates it causes a suction at its center that pulls the stock towards it. Centrifugal force then causes the stock to flow rapidly over the rough carbide particles. This effective dynomizing action completely disintegrates the stock . . . separating each fibre from its neighbor while maintaining its original length.

Write for complete information.

RICE BARTON Research Corporation
WORCESTER 1, MASS.

corporated on the press which may be used with rewind or sheeter.

The Wickersham Press Inc. (New York) by using split fountain procedure on a two-color sheet-fed press was able to print a cosmetic color chart in 22 colors. Each fountain was divided into 18 sections. The inks were specially mixed and checked to keep them in exact color. If the job had been printed conventionally, it would have taken 11 passes through a two-color press. Printing was done at 3000 sheets per hour.

Hires, Castner, and Harris, Inc. (Philadelphia) have a four-color high etch, relief, dry offset press. The press is a combination web, sheet-fed press, the paper being sheeted before it enters the printing units. The plate cylinders can be registered by moving forward and backward as well as sideways. The plates are 0.032 magnesium.

The McCorquodale & Co. (London, Eng.) have a fully automatic stream feeder press capable of 1200 impressions an hour. The number of colors that can be printed are limited only by the number of ink receptacles which can be held in an enclosed fountain. There are 72 at present. The ink is applied under pressure. Special inks are required of high-gloss materials similar to cellulose paints. The press is run in tandem with a heat drying unit.

Crawford, Inc. (*10*) have designed a hybrid press which prints offset-gravure or color and process color by letterpress with rubber plates. The gravure prints on a rubber offset cylinder and then on paper. To convert to letterpress, the offset cylinder is removed and a plate cylinder installed which mounts rubber plates. The gravure cylinder is replaced by a "celemeter," a gravure cylinder engraved with very fine cells which feed the ink to the rubber plates in a very uniform film. Conversion can be made in 20 minutes. Dehydrating driers are used to dry the ink.

The Perfex Co. have a photographic, letterpress process. The plate consists of a colloidal (plastic) surface which can be exposed photographically. The development of the plate prepares it for direct use as a printing plate. No etching or gelatine is required. Direct color separations can be made very cheaply.

Xerography, invented by C. F. Carlson at Battelle Memorial Institute, has come into commercial use in the Xerox Copier which can be used as an office machine for the production of $8^1/_2$ by 11-inch prints. Plates can be photographed directly from original copy with a camera.

PRINTING PLATES AND EQUIPMENT

The Coates BiMetal Plate (*11*), chromium on copper, has been studied and it is stated that the over-all cost equals that of a zinc deep-etch plate in runs of 200,000 impressions, but is cheaper when longer runs are made.

A. B. Esselte, British pat. 631,858, has a method for producing bimetallic plates on a thin sheet, metal carrier (preferably zinc) in which he clamps the thin metal to a thicker base of a metal of higher specific conductivity than zinc (e.g., copper) and then chromium plates. This eliminates the harmful effect on the thin metal of the excessive heat generated due to high resistivity and high-current density.

H. R. Watson and A. T. Ward have a patent (British 626,693) for a method of treating aluminum and aluminum base alloys to remove the oxide coating before electroplating. The method consists of immersing the aluminum in hot dilute aqueous solutions of a sodium compound, a nickel compound, a tin compound, a carbonate, a chloride, and a hydroxide. The required chemicals can be supplied by $^1/_4$ ounce of tin chloride per gallon of water, $^1/_4$ ounce of nickel carbonate per gallon of water, and 3 ounces of caustic soda per gallon of water.

K. Martin (*12*) has reported on the use of a photographic emulsion as a stencil in offset platemaking. Satisfactory exposure can be made in 15 seconds with a No. 1 Photoflood light at 7 feet. He has applied for a patent.

W. G. Mullen, U. S. pat. 2,444,205 (June 1, 1948), has a lithographic plate made by coating a water-resistant base sheet with a casein-resin primer, a layer of pigmented casein, a layer of a mixture of water-soluble and water-insoluble polyvinyl alcohol, and an outer layer of polyvinyl alcohol and casein. The top three layers are sensitized with bichromate.

The CFC Process (Charles F. Clerkin Co.) (*13*) treats a plate with a presensitized solution and then a lacquer. The plate is then ready for exposure. It is said to be free from the trouble experienced with albumin-coated plates. The coating is nonspoiling and somewhat faster than an albumin coating.

Kalle & Co. (French pat. 904,255) have a process for making zinc or aluminum plates using a light-sensitive diazo compound without the addition of colloids.

The "Alcoat" process of Algraphy Ltd. (London) (*14*) is an anodized aluminum plate. The plate is grained before anodizing. Nitric or sulphuric acid is used as a counter-etch. A higher Baumé than normal albumin coating is used and for deep-etch a saturated solution of iron perchloride (ferric chloride) is used. Two hundred line halftones can be printed on the plate which is highly desensitized and only a gum solution is needed in the fountain. It is possible to make additions or deletions on this plate.

A presensitized lithographic plate has been reported by Robert E. Rossell (*15*) which can be taken from the package, exposed, and gummed in 3 minutes. The film is a cellulose acetate which has been treated to produce a saponified surface on one side. This surface is hydrophilic and repels grease or inks. The surface is coated with a light-sensitive diazo compound which, on exposure, decomposes to a product which tans the surface. The plate then has the ability to carry moisture and functions as a litho plate. The surface of the plate is smooth and hence permits very fine dot structure. When properly packed, the plate will withstand prolonged periods of storage. The film is mounted on some form of light,backing material to reduce cost and improve dimensional stability.

A new method of coating plates has been instituted in Verticote (*16*). The plate to be coated forms the fourth side of a rectangular tank or fountain in which the coating solution is contained. Coating is accomplished by filling the fountain with coating solution and drawing the plate vertically upward. The capillary action of the surface of the plate gives an extremely even coating.

United States pat. 2,476,413 (July 19, 1949) to Robert L. Heath and Edmund C. Huxley consists of a method of regraining aluminum lithographic plates by removing old coating by immersing the plates alternately in sulphuric acid and then in an alkali metal carbonate solution. The plate is then regrained in an aluminized alkali metal carbonate solution.

Regraining of lithographic plates is accomplished by Vapor Blast (*17*). The plates are clamped on a drum carrier which rotates as the vapor-blast unit passes back and forth over the surface stripping old work from the plate and regraining the surface with a water abrasive which gives a very smooth uniform grain. The Swedish "System Lindmark" uses a rotating drum with sandblast for the same work (*18*). United States pat. 2,495,269 (Jan. 24, 1950) to Johan Gunnar Lindmark also recommends this system for the preparation of offset rubber blankets.

William Craig Toland and Munroe H. Hamilton, U. S. pat. 2,453,735 (Nov. 16, 1948), have a fountain solution roller which consists of a roller covered with a water-swellable material which includes a water-soluble dibasic acid.

C. E. Larson (British pat. 601,883) supplies different quantities of fountain solution to the plate by dividing the dampening device into a series of belts formed by a series of rolls side by side or a single roll cut in annular grooves or by a number of rings fitted on a shaft.

C. Walker Jones Co. (Philadelphia) have a new dampening roller covering "Seamol" which has a smooth surface similar to molleton. There are no seams, but a two-way stretch which makes it conform closely to the under surface prevent-

HOW NEW 2-DIAMETER LIME SLUDGE KILN

Cuts Fuel Costs!

New Fibreboard Products Mill Gets 3 Important Benefits:

- *Enlarged firing zone provides greater internal volume for fuel combustion... plus greater heat transfer area.*
- *Heavier lining for enlarged portion of kiln is possible without restriction of kiln opening as in single diameter kilns.*
- *Heat recuperating chain system adds heating surface, reduces dust loss, gives low flue gas temperatures.*

KILN FUEL CONSUMPTION was minimized at the Fibreboard Products mill at East Antioch, California, with this new rotary lime sludge kiln.

The 2-diameter kiln has a 60′ enlarged section of 8′ diameter at the discharge end, tapering to 7′ diameter for the remainder. This relatively small diameter and long length provides the slenderness ratio necessary for good fuel economy. In a long kiln the calcining zone is extended and provides a longer retention time at lower temperatures, reducing fuel consumption.

Design features of Allis-Chalmers lime kilns include: ▸ floating type riding rings; ▸ forged steel rollers; ▸ heat recuperating chain systems; ▸ drives arranged to eliminate effects of torsional vibration.

Allis-Chalmers also supplies feeders, slakers, burning equipment, dust collectors and fans, and master control panel equipment. Allis-Chalmers motors and *Texrope* V-belt drives meet toughest requirements of rotary kiln operation.

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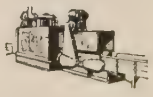
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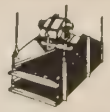
VIBRATING SCREENS

HI-DENSITY FEEDER

ROTARY KILNS

AND OTHER EQUIPMENT FOR PAPER MAKING . . .

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ALLIS-CHALMERS A-C ALLIS-CHALMERS

ing slipping and twisting. The material has a very high absorption quality.

Lawrence J. Grennan, Hartford Fire Insurance Co., has invented a means for improving dampening control (*19*). Drill and tap the end of a roller stock to hold a stud bolt. Silver solder a steel band to a ball-bearing unit with a loop to hook a spring. When a unit is placed on both ends of the dampener roller and fastened with a spring, the roller will not slide or skid when passing over the cylinder gap. The gadget also holds the roller in close proximity to the brass, water roller.

Roberts and Porter, Inc., have a new vertical roller recovering machine. It is speedier and simpler to operate than the horizontal type. It takes rolls up to 66 inches in length and any diameter. The core of the roller is inserted in the guiding tube and the device covers the roller with a smooth fit.

The Linmac Engineers Ltd. (England) have a lithographic plate stretcher, which it is claimed can stretch a plate from 0.003 to 0.109 inch on plates up to 52 by 57 inches in size.

The Kenman Engraving Process (*20*) prepares a printing plate from the film itself. No metal is employed except for a base. Photographic equipment is required to make the plate.

The Reynolds Printasign Co. (Chicago) suggest the use of their equipment for the preparation of lithographic copy. It can be used for display lines in copy paste-up. The equipment has hydraulic automatic spacing which controls spacing to 0.005 inch.

Prescreened Glossy Prints have been in use by the *North Virginia Free Press*, Arlington, Va., for the illustrations. Composition is done by the Vari-typer and all work is photographed as line work.

The Graphic Plate & Supply Co. (Tulsa, Okla.) have a graphic ruling equipment. The copy is smooth and accurate for reproduction. It is usually drawn double size and reduced by the camera for sharpness and fineness of type.

Norman Mack (*21*) uses an air eraser for removing unwanted work on a deep-etch plate. Staging-out can be eliminated and much time saved by this process. It helps in fading out a vignette and in lightening a heavy shadow. An area can be cleaned and regrained with the eraser to hold set-in work on deep-etch plate.

The National Starch Products Co. have a modified starch "Clear Flo" which is a sodium salt of an ungelatinized starch acid-ester derivation, containing carboxylic and sulphonic acid groups. Tests using this material as a desensitizer rate it between CMC and gum arabic.

The *Lithographer's Journal* has an article which suggests the use of CMC as a plate etch only and gum arabic for gumming up (*22*).

Time, Inc. (*8*), have a copper plate sensitized with a resinous emulsion which hardens to form an electrolytic resist in the image areas when exposed to light. The unhardened resist is removed and the areas chromium plated in the non-image areas. The resist is removed giving a series of copper bottomed wells in the image area similar to gravure. The wells are straight sided and give faithful reproduction.

PHOTOGRAPHY

Photo Maskoid, a red liquid, can be applied by a brush or pen to a photographic surface. The liquid forms a chemically resistant film which is actinically opaque. It can be peeled off without affecting the surface in any way. It can be used to protect any part of a plate, negative, or print during chemical treatment as in local reduction or intensification. The material is handled by Andrew Jeri Co. (New York).

A reducing medium for photographic prints and negatives in "Etch-A-Dine" is said to permit smooth reduction of broad areas as well as fine lines. The active ingredient is iodine and various reducing speeds can be obtained with various strengths of the solutions (*23*).

A chemical erasing solution for silver images is the subject of U. S. pat. 2,494,765 (Jan. 17, 1950), John F. Kienast. The solution is a 3 to 50% cupric chloride and 25 to 5% ammonium chloride. After treatment with this solution, the area is treated with a substantially saturated solution of thiourea and then the resulting solution is removed.

The Danat process (Danat Typographers, Inc., Chicago) gives reverse type by a purely mechanical method. After a primary black on white proof is pulled, the reverse proof is placed in a contact printer with a sensitized paper face to face, exposed, and the paper developed, giving a white on black.

The use of an intaglio press for coating photographic emulsions is the subject of German patent application 38,316. Thinner and more uniform coating can be obtained in this manner than by the conventional coating methods and higher speed can be obtained.

Eastman Kodak Co. (*24*) have a method for converting black and white to full color, called the Kodak Flexichrome process. Color dyes are used to convert a special photographic print to a colored one. The dyes are applied by brush. They are true dyes and not water color or oil paints. This company has also developed the Kodalith Blue-sensitive film for graphic arts. It is a film with no antihalation backing. It is designed for use where the image is reversed by exposing through the back of the film. A special "Thin Base Film" for use in gravure printing and layout has a base of 0.0035 inch thickness. The other characteristics are the same as the standard commercial film. The new Ektachrome technique reduces the time of processing by approximately 25% and the developed negative can be examined within 14 minutes after processing is started. The Kodak Ektacolor film has colors which are complementary to the final print. This simplifies the making of color prints and photomechanical reproductions by eliminating the need for masking and for separation negatives. It is professional film which can be processed in the studio. The Pan Matrix film permits positive color printing matrices to be made direct from Ektacolor transparencies by either contact or enlarging through filters, without any intermediate steps. A black-and-white proofing paper for use with Aktacolor film and a Kodak vacuum register board, which speeds printing with the Pan Matrix film, are part of new products of Eastman Kodak Co.

The Haloid Co. (Rochester, N. Y.) have a transparent paper negative called "Transaloid." The resolving power is close to that of film. It will give halftone work up to 133-line screen. The negative has high contrast and high density. The emulsion is on a transparent, water-resistant base which has freedom from paper grain.

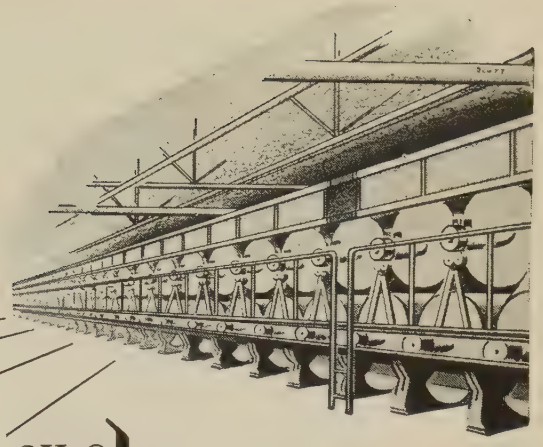
Rudolf Fritsche (Jackson Heights, N. Y.) has Para-Accelerine, a chemical product which will extend the active life and speed of photographic developer and it can be left open all day, bottled, and reused again the next day by the addition of only small quantities of the chemical each day.

S. D. Stookey (*25*) reports a photosensitive glass has reached the commercial stage. Colored photographic images can be produced within the glass by exposure to ultraviolet light through a conventional negative. Development is accomplished by heat treatment. Various colors may be produced. The image is three dimensional and extremely fine grained. Practically no scattering of light occurs through such an image. A possible use is the production of halftone screens.

United States pat. 2,459,136 (Jan. 11, 1949), Sam Charles Slifkin, assigned to General Aniline & Film Corp., is for a base having a coating comprising mercuric chloride, ammonium oxalate, and ferric oxalate. This coating is exposed to an image and then to ammonia. The result is a dry developed negative.

The Gevaert Print Method (Gevaert Co. of America, Inc., New York, N. Y.), gives monochrome prints from color films. The method includes the use of "Diaversal" paper for con-

A simple chemical equation but a manufacturing headache...



$$2Cl_2 + 3Ca(OH)_2 = Ca(OCl)_2 + CaCl_2 + Ca(OH)_2 + 2H_2O$$

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tacting or enlarging. It will make sepia prints from large color films or enlargements from small movie frames.

Henry Korn (New York, N. Y.) is making Plexiglass etching trays which will withstand corrosion from any chemicals normally used in photography. The trays are chip-proof, light, and strengthened by reinforced curved corners and rolled edges.

The American Standards Association have approved twenty-four photographic chemicals standards. Twenty-eight additional standards are being studied.

RESINS AND CHEMICALS

Amberlite W-1 (*26*) is reported when used as a spray on the wet paper web to increase the tensile strength, pick resistance, fold, and abrasion resistance.

Admerols, produced by Archer-Daniels-Midland Co., are produced from the glycerides or fatty acids reacted with such materials as butadiene, styrene, pentaerythritol, cyclopentadiene, acrylic acid, sorbitol, and other chemicals. They are said to have unusually fast setting and drying characteristics, low acidity, excellent stability, high gloss, and color retention.

Armid HT (Armour Chemical Division of Chicago) acts as an antioffset material, produces a nonscratch ink and aids in shortening ink without changing the consistency. Two per cent will allow overprinting without reducing the luster of the inks.

Isopol Resin (Union Bay State Co., Cambridge, Mass.) is a copolymer of styrene and isoprene (75 : 25). This resin is completely soluble in petroleum naphtha, clear, fairly hard, and nearly water-white in color. It improves alkali and acid resistance and adhesion to smooth surfaces.

Panopol 2-C (Pan American Refining Co.) is an oil, moderately bodied, clear reddish but essentially colorless in thin films, and dries to a tough, hard alkali-resistant film. It is said to be cheaper than linseed oil.

Polene (Western Laboratories, Inc.) possesses outstanding wetting qualities and aids in rapid pigment dispersion. It has low acid number, will not liver, is generally noncrystallizing, and has a positive drying action, preventing after-chalking.

Ultrol (Spencer Kellogg & Sons, Buffalo) gives a hard, elastic film resistant to water and alkali. It dries in 3 hours with a minimum of drier, acts well on porous surfaces, and is a styrene derivative of soybean.

New resin-forming chemicals (*27*) in the form of isocyanates and di-isocyanates are made when reacted with alcohols and polyalcohols. When reacted with drying oils containing free hydroxyls or carboxyl groups, they dry rapidly, possess outstanding water resistance, are miscible with various solvents, and yield high gloss. Five to ten per cent produce the desired results. The best results are obtained with a chlorinated phenylene di-isocyanate.

Gordon Bartels Co. (Rockford, Ill.) has a white, roller-coating material which resists yellowing or scorching at 500 to 600°F. in metal decorating. The Watson-Standard Co. (Pittsburgh) also have a varnish for wet and dry printing for metal lithography. It will level out over any type of finish and will not wrinkle, go flat, or bleed.

Allyl starch (*28*) is a cream-colored solid, soluble in many organic solvents and hydrocarbons. It should be valuable in oil-resistant aniline inks and gravure inks. It can be used for coating and impregnating paper and textiles.

Trimethyl hexanol (*29*) is a long-chain primary alcohol, the esters of which have promise as plasticizers. As an additive it improves the viscosity of oils. The cobalt and lead salts are effective driers.

Compolene (Western Laboratories Inc.) is an ink compound which can be used without danger of interfering with the drying of the ink. It helps water resistance of litho inks and is said to be beneficial to the plate. It eliminates offset, picking, mottle, and the use of offset spray. It can be used with gloss and overprint inks without impairing the gloss or abrasion resistance of these inks.

Apic (American Printing Inks Co.) is an ink conditioner containing no grease or wax. It reduces tack without reducing the body of the ink, or drying.

The Monsanto Chemical Co. have Lustrex X-810 polystyrene, a resinous thickening agent for latex systems and resin in water emulsions.

The Cargille Scientific Inc. (New York) have a masking or odorant for printing inks called "Coffee-Captain." It is water-white, completely miscible with most organic liquids, and possesses an aroma suggestive of roasted coffee.

ADHESIVES

National Adhesives have developed an adhesive for polyethylene film which can be used in high-speed fabrication of polyethylene lined kraft bags, polyethylene to kraft, to cloth and burlap, and to polyethylene.

The Dennison Manufacturing Co. have a water moistening gum for adhesion to moistureproof cellophane. The nature of the gum requires special inks be used in printing. The gum is carried on No. 57 white, lightweight, coated stock. It adheres to enamel, varnish, lacquer, lithographed surfaces, and to cellulose acetate and pliofilm with special moistening solution.

Swift & Co. have a continuous closed system for drying glue by the use of continuous belts which carry the glue through several air chambers at different speeds and different temperatures. The glue emerges in clumps resembling raspberries. These are ground to small uniform particles. The method prevents contamination with dust, wood, or other materials. It is called New Process glue.

Charles R. Bragdon (*30*) reports on a study of adhesion. The "Adherometer" tests adhesion of organic coatings to metal surfaces. A knife edge actually removes the film from the surface and the force required to effect the removal is measured quantitatively.

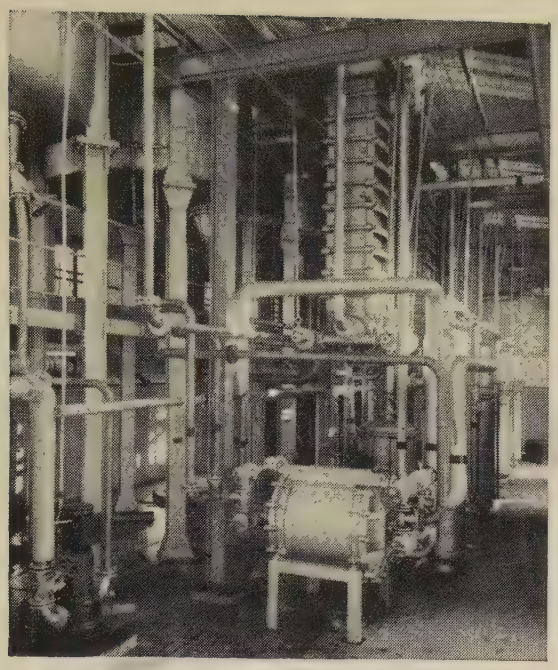
INSTRUMENTS

E. Fridori (*31*) reports on experiments for evaluating the printability of printing papers; a method for determining the ink distribution between form and paper, the capacity of the paper for absorbing and quickly fixing the ink, the degree of blackness, strike-through, and ink requirement.

The Precision Scientific Co. are manufacturing the viscometer designed by the Interchemical Corp. It is a high-speed, wide range viscometer which measures the flow properties of printing inks in accordance with the principles of modern scientific rheology. It produces consistency curves in place of single point measurements. It consists essentially of a rotating cup containing the sample and a stationary bob immersed in the sample. When the cup is rotated at the predetermined speeds, a viscous drag is imposed on a coiled spring supporting the bob which is twisted through an angle measured on a calibrated disk. The speed of rotation of the cup may be varied from 10 to 400 r.p.m. in steps of 10 r.p.m. The consistency curve is produced by changing the speed over a series of steps from low to high and back again. John E. Tyler (*32*) reports on the use of this viscometer in gravure inks.

R. P. Bowles and Aileen Silcox (*33*) report on a method for determining the ink absorbency of paper. The standard ink consists of 60 parts by weight of anatase titanium dioxide and 40 parts by weight of linseed oil having a viscosity of 80 poises at 25°C. The mixture must mature several days. The ink is printed on a Vandercook proof press with a PATRA printing shell, and absorption is measured with a reflectometer. Although the method is empirical, it gives useful results close to industrial practice. It appears capable of theoretical treatment and further work along these lines is in progress.

A portable thickness detector (*34*) is reported for nondestructive thickness measurement of steel, copper, alu-



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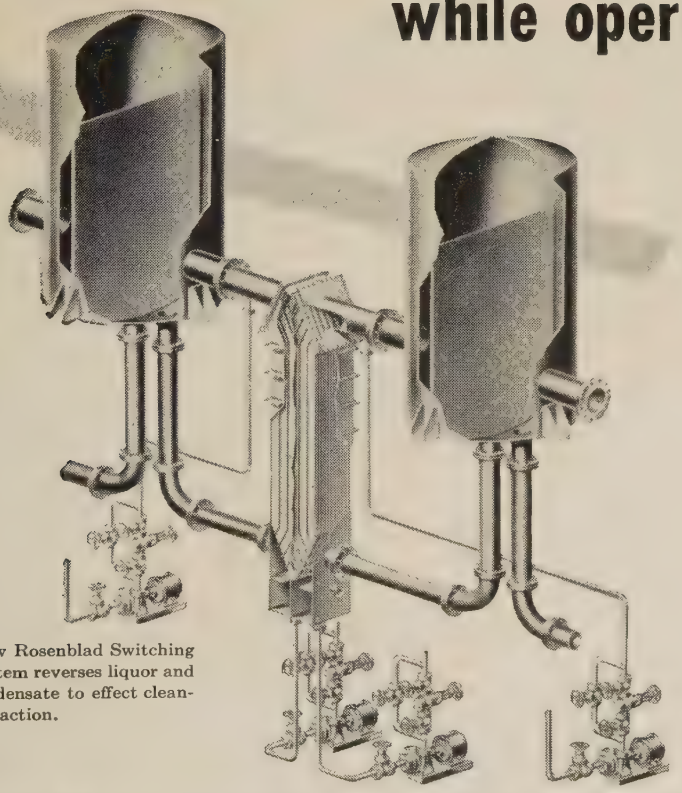

How Rosenblad Switching System reverses liquor and condensate to effect cleaning action.

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minum, glass, unfilled plastics, and other materials. In operation, a quartz crystal in the gage head, powered by an electronic oscillator, generates ultrasonic waves which are transmitted into the material under test. Resonance in the material is indicated by a milliammeter and headphones. A scale on the panel allows conversion of the frequency of resonance to thickness.

Instruments, May, 1949, reports the Pico Surface Comparator. It checks a surface against an approved sample.

Paul W. Dorst (*35*) gives a report on a practical microscope for lithographers. It has an integrated light source which can be varied from a glancing beam to vertical. It gives information about the surfaces of plates, coating, blankets, paper, and inked images. Important depths can be calculated knowing the angle of illumination and measuring the length of shadows.

Everett F. Carmen and William F. Huck have developed an Ink Dryograph. The instrument tests drying of 24 prints over a period of 26 hours. The drying is recorded by a carbonizing print. An attachment for testing scratching and rubbing is added. P. Fremy (*36*) makes a drying test by carbonizing a print, using a glass stylus under 500 grams of weight.

PHOTO-COMPOSING

The Fototype Inc. (Chicago) has a process of making offset duplicator plates by direct image method. Headlines are made by pasting phototype on a metal or paper plate. Typewritten body copy and art work are positioned by hand. The plate is then put on the press and printed. Additional paper plates may be made from the original. The process is good for 5000 impressions.

The Justowriter (*37*) works from a Trial Copy Machine, which is an electric typewriter which types and punches a tape and notes justifying information. The tape is run through the Automatic Justifying Copy Machine which retypes automatically and justifies 800 lines of newspaper straight line material in 1 hour.

A Photo-Typesetting system, manufactured by the Lithomat Corp. (*38*), operates with a standard typewriting keyboard and platen which writes the work on copy paper. The operator proofreads his work and can make corrections by pushing a button which rubs out erroneous letters and sets the carriage in position to make corrections. A lever actuates the photographing process. Editorial corrections are made by stripping and substituting new characters. The characters to be photographed are on a rapidly revolving glass disk on which it is possible to superimpose a complete font of a given family type.

H. J. A. de Goeij, Haarlem, Holland, inventor of the Hadego Photo-Composer, uses plastic block matrices: which are set by hand in a special composing stick. The stick is placed in the machine and the size calculated. The exposure is controlled by a clock. There are two sets of matrices: 48 points which give images from 20 to 115 points, and 20 points which give 8 to 48 points. The control disk on the front of the machines calculates enlargements or reductions of image size.

The French have a Lumitype, a new photo-typesetter which is being perfected at Cambridge, Mass. This machine makes it possible to make corrections and use different type faces.

The Cardon (*39*) photo-composing machine is still another machine.

MISCELLANEOUS

There are several silk screen presses now on the market. The General Research & Supply Co. (Grand Rapids, Mich.) press prints up to 1500 impressions per hour, handles paper, plastics, films, and cardboard. The Century Studios (Chicago, Ill.) have the Kenney automatic silk screen press. It speeds up production, provides for a harder and more uniform deposits of materials, and gives a more accurate registration. The press is equipped with a suction base for decal and paper work and a strong magnetic base for metal. On poster work the average speed is 600 to 700 impressions per hour. Sherwin Williams have an autopositive photographic film which prints directly to a positive and permits photographic preparation for silk screen printing without the necessity of a darkroom.

The Transcolor Corp. (Palo Alto, Calif.) have a process called Proof-positive. Prints are made from positives, and the result is a set of four dyed films, which are superimposed in register to form a color image. Dyes may be manipulated to match lithographic inks.

The Kalamazoo Michigan *Gazette* mounts zinc photoengravings, 0.064-inch originals, on stereotype plates. The photoengraving is curved and mounted in a depressed portion of the stereotype plate. Double-faced Scotch tape is used in mounting the zinc photoengravings. Scotch tape can also be used to prevent type work-ups.

The Bishop pre-makeready process introduces varying printing levels into the surface of a printing plate. It eliminates three fifths of the down time for makeready by building makeready into electrotypes, obviating the necessity for overlaying or underlaying or other makeready after the plates are on the press. Type and middletones are kept at the travel line of the press with solids 0.002 inch above the highlights and vignettes 0.002 below (*40*).

A new halftone screen has been made by Buckbee Mears (*41*). The cross lines are etched on a single sheet of glass. The etched lines are pigmented or rendered opaque by filling them with a deposit of ferric oxide. There is no cover glass which gives a slight difference in the screen separation. It produces faster exposure with less defraction and gives improved shadow rendition because of a 10% rounding of the etched crossline intersections. It produces a smoother portrayal of grays and middletones by reason of the rounded dot formation. There is a greater permanence through freedom from bubbles and discoloration. It has a provision for matched and angled screens for color work, permitting color reproduction to be made to the size of the camera capacity.

A new "locking chase structure," H. J. Hilland (*42*), has a device for locking up type forms without chase, or locks up the form with chase and lockup and makes up on the galley eliminating string tie-up and furniture. It consists of four movable bars that can be moved to any desired position and locked securely by a worm gear. The lockup fits any chase, press, or galley. Forms may be twisted or moved a fraction of measurement in any direction without disturbing the locking up mechanism.

The R-B Sales Co. (England) has a series of interchangeable slotted self-locking chases, which are steel of uniform 36 point gage, cut into lengths in half-inch rises from 2 to 15 inches, and then 1-inch rises to 24 inches. Each length is tapped and threaded at one end to hold the locking screw which passes through the slot at the buttoning end of another piece. The members are made 3 points shorter than standard em lengths, insuring tight lockup.

The Challenge Machinery Co. (Grand Haven, Mich.) have a double-wedge quoin which gives direct expansion, reducing damage to type slugs.

The Barco Chemical Co. (*43*) have a plastic sponge which is not affected by mild acids, alkalies, washing compounds, or soaps. They give four to five times the wear of cellulose sponges. The sponge has a velvetlike texture when wet and wipes dry like chamois. It may be boiled or sterilized without affecting its structure.

The *American Pressman*, April, 1950, shows an instrument for making photocopy. The small size is $8^1/_2$ by 11 inches and operates by hand. Any subject matter can be duplicated by the "Copy Roll."

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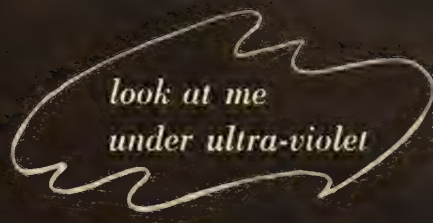

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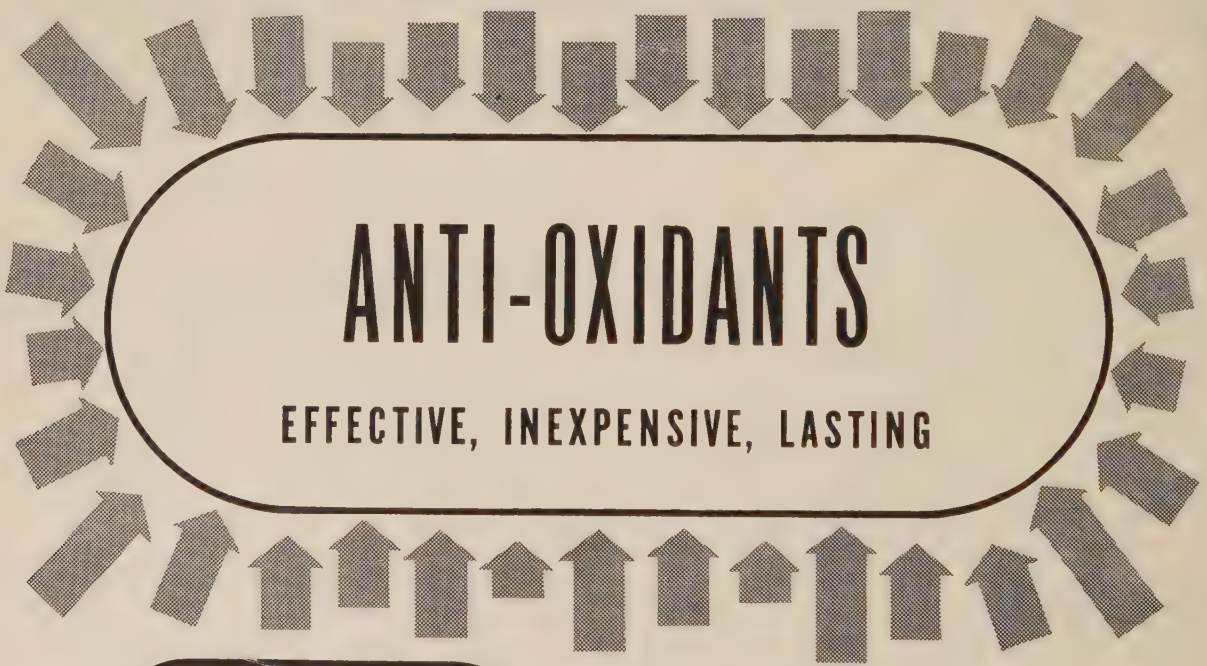

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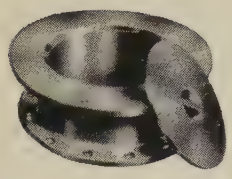
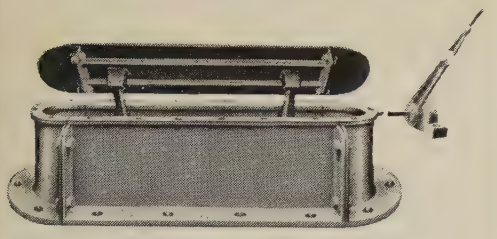
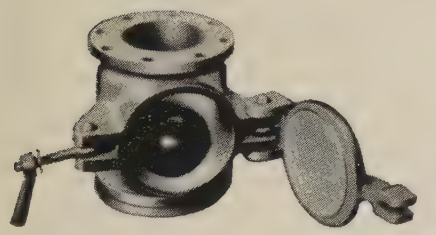


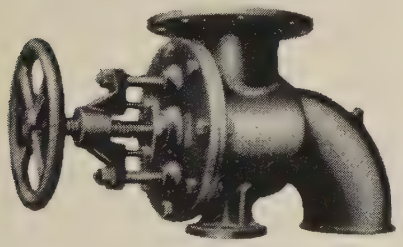
Hook operated beater dump valve.



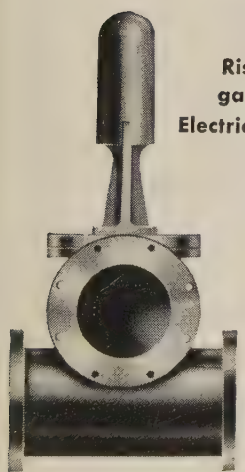
Oblong type beater dump valve.



Ball check valve.

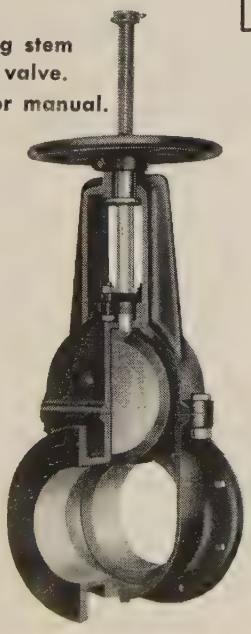


Beater hydrant valve.

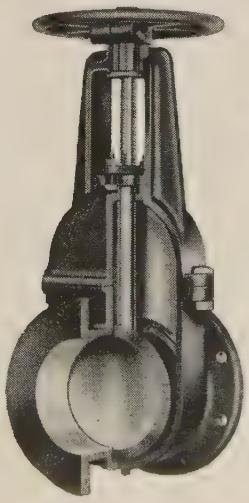


Pressure relief valve.

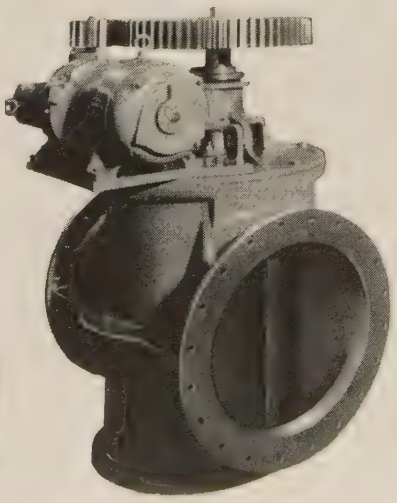
Rising stem gate valve. Electric or manual.



Non-rising stem gate valve. Electric or manual.

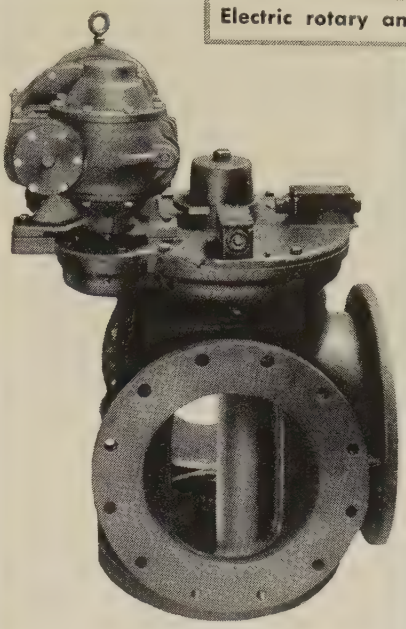


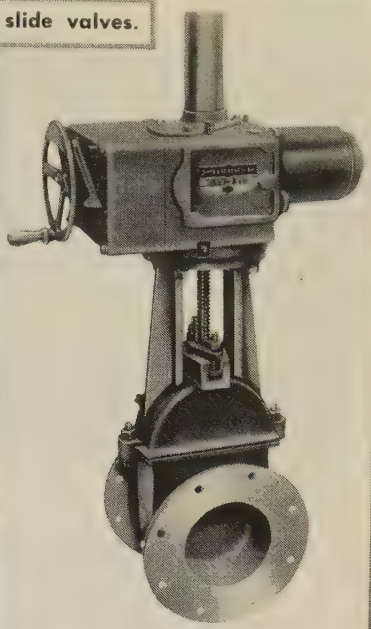
Hope type rotary valve. Electric or manual.



Slide valve. Electric, HYDRAULIC or manual.

Electric rotary and slide valves.





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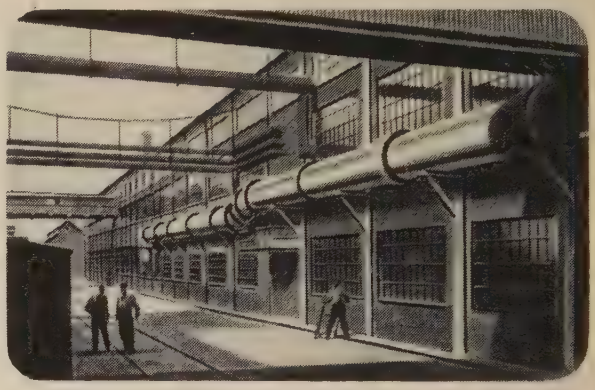

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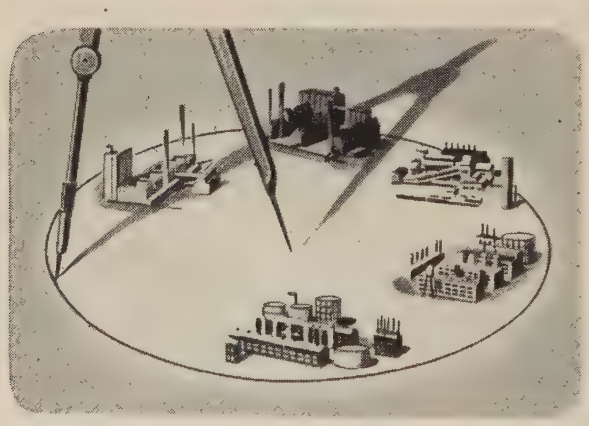

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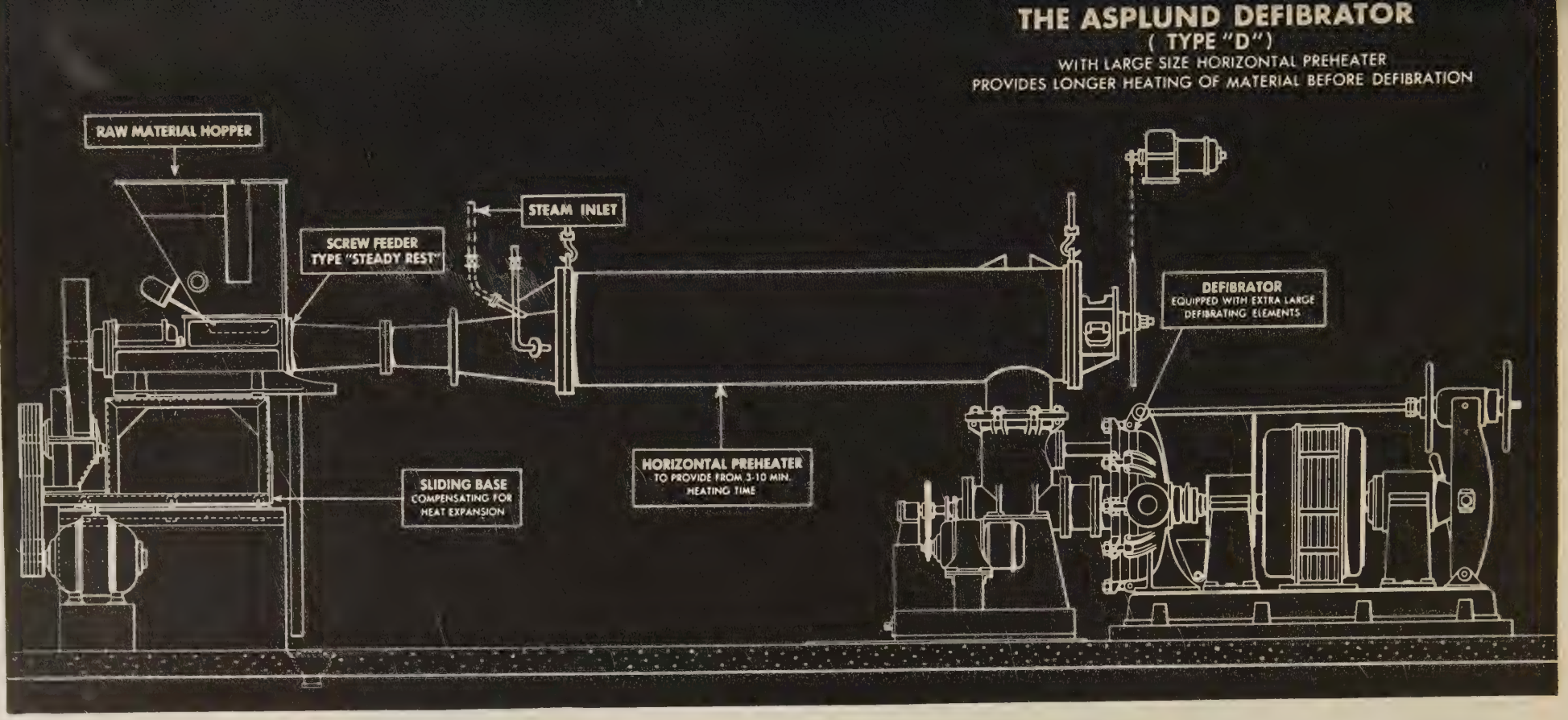

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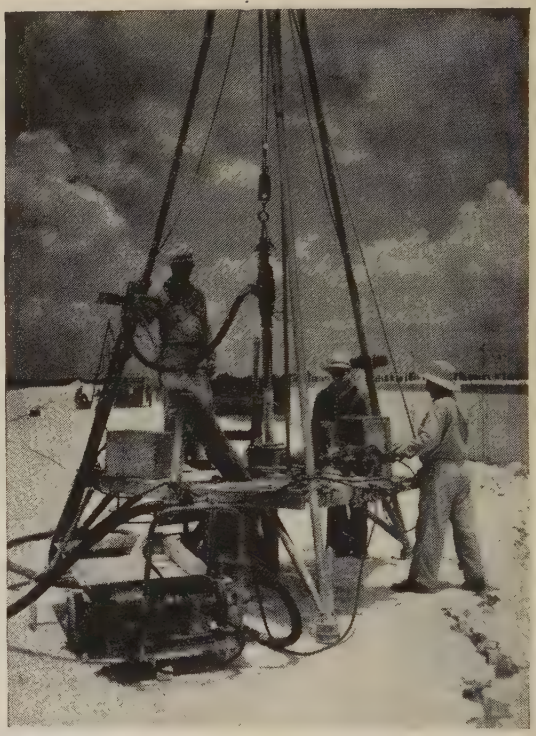

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NUMBER 6 OF A SERIES FROM THE J. M. HUBER CORPORATION LABORATORIES

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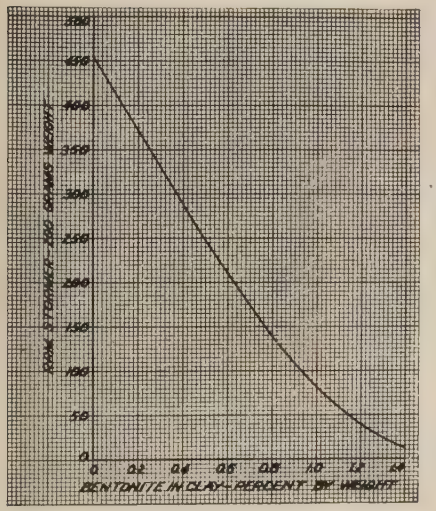
SCREEN RESIDUE (GRIT) CONTENT OF PAPER CLAYS

High quality paper grade clays should be as low as possible in coarse material. High grit content is objectionable because of its abrasiveness and the fact that it is likely to mar the final surface. Grit is usually expressed as the residue failing to pass through a screen of specified mesh. The screen residue of filler grade clay is most often determined on both 200 and 325 mesh screens; a 200 mesh screen is usually used for coating clays.

SCREEN RESIDUE OF HUBER PAPER GRADE CLAYS

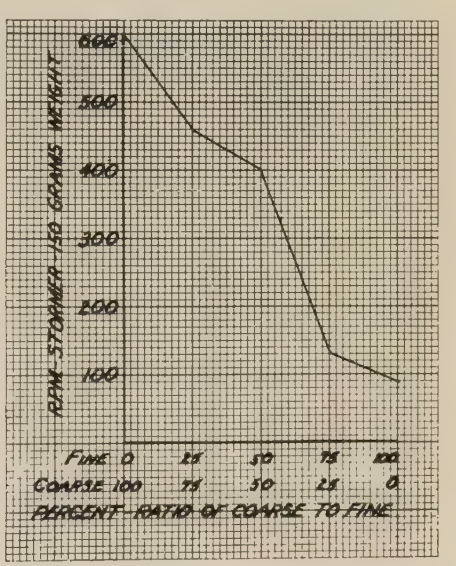
	Hi-White	*Paragon*	*Washed Filler*	*Special Hydratex*	*Hydratex*
Type	Filler	Filler	Filler	Coating	Coating
Screen Residue (200 Mesh)	.05%	.05%	.05%	.005%	.007%



Effect of Bentonite on the Flow Characteristics of a 70% Clay-Water System.

HOW CLAY FINENESS AFFECTS VISCOSITY OF CASEIN COLORS

Addition of increasing amounts of fine clay results in increasingly viscous casein color suspensions. The figure shows the viscosity changes produced by additions of a very coarse clay (40–50% finer than 2 microns) to a very fine clay (95% finer than 2 microns). The formula consisted of 42% total solids with 15 parts casein to 100 parts of clay.



Effect of Various Ratios of Coarse and Fine Clays on Flow Characteristics of a Clay-Casein Color (42% Total Solids).

EFFECT OF MINERALOGICAL COMPOSITION ON FLOW CHARACTERISTICS OF CLAY-WATER SYSTEMS

Of the three main groups of clays, the montmorillonites have a marked effect on flow properties. These extremely fine grained clay minerals have a tendency to gel in the presence of water. In some cases a clay deposit may be rendered unsuitable for the production of paper coating clays because of the presence of excessive contaminating montmorillonites. The neighboring figure shows the adverse effect on viscosity of increasing concentrations of montmorillonites (bentonite). In each case viscosity tests were made on slurries containing 70% total solids, first on the pure clay-water mixture, and then on mixtures containing increasing percentages of bentonite, all dispersed to maximum fluidity.

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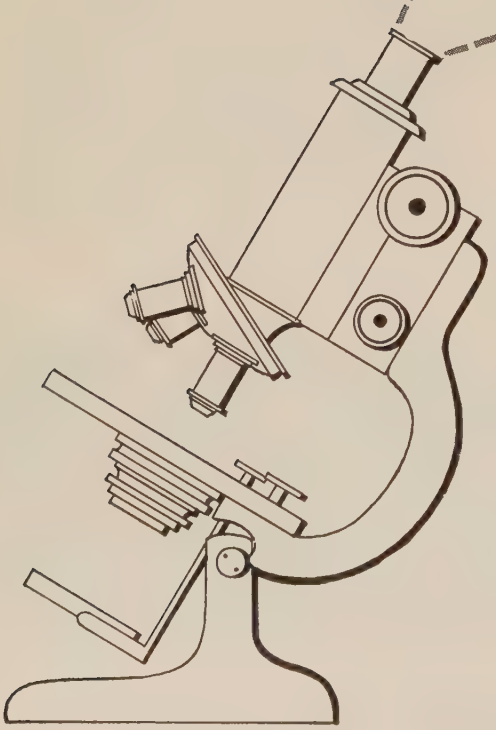

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Pressure Washing of Kraft Brown Stock

ERIK ZIMMERMAN and HENRY VRANIAN

A description is given of the newly developed three-stage continuous pressure washing system which has proved successful on board stock at a kraft pulp mill where two 300 air-dry ton lines are in operation. The equipment is quite different from any other system, resulting in safe operation with considerable economy in water, heat, and space. Plugging difficulties have been successfully solved. Foam difficulties caused by air entrainment are eliminated because the system is maintained at pressure. In the presses the pulp is subjected to high pressures, discharging it at 37% moisture-free consistency, forcing liquor from the uncooked particles. Several pressings are made according to the number of stages desired, and between pressings, the stock is repulped with counter-current liquor. Consequently, excellent separation is obtained between stages. Due to the intense pressure and rubbing action in black liquor at 200°F. temperature, there is indication of some fiber strength development. The total water consumption for the 300-ton system is 180 g.p.m. with temperatures exceeding 200°F. The high wash-water temperatures allow more efficient blow-heat recovery and sends hotter liquor to the evaporators. On account of high consistencies the filtrate volumes are small, so that large pipe lines and large pumps are not used. This factor is responsible for considerable power saving. The total power consumption for a three-stage 300-ton system is 1.36 hp. days per air-dry ton. Because the equipment comes in compact integral units, there are many possible variations and arrangements permitting economical use of space.

THE object of this paper is to describe the newly developed 300-ton kraft brown stock pressure-washing system, and to present some theoretical considerations concerning it. There are two systems in operation on board pulp. The working parts are entirely different from any other system.

The present system is in three stages (Fig. 1) composed of an underflow thickener followed by the three presses in series, designated A, B, and C. The thickener receives the blow-tank stock, delivering it to the A press. Between the presses, the stock is repulped with counter-current liquor, water being the repulping medium ahead of the last press.

STOCK FLOW

The digesters are blown into a blow tank of conventional design equipped with an agitator and an electronic consistency regulator.

From the blow tank the stock is pumped at 5% moisture-free consistency to an underflow thickener discharging at 11% moisture-free into the A press feed chute (Fig. 1).

This chute is equipped with a stock-level recorder for regulating the stock valve, 1. At present, this valve regulation is manual but will be changed to automatic.

At the point of entry into the A press is a small liquor inlet, the valve 2, which is controlled by the load of the A press drive. Liquor from the B press, averaging 40 g.p.m., is added here as a final consistency adjustment.

The stock discharges from A press around 37% moisture-free consistency and is repulped with the C filtrate liquor as it drops into a screw conveyor going into the B press. The pressing is again repeated to about 37% consistency, and the stock is repulped this time with the wash water as it drops into the screw conveyor going into the C press. Again the pressing is repeated to 37% consistency and the stock is conveyed directly to the high-density storage tank. At lower tonnage rates the press discharge consistency can be higher, around 40%.

LIQUOR FLOW

The thickener filtrate passes through a level control valve and is available for the evaporators without any further filtration. Part of this liquor is automatically diverted to the dilution tank for blow tank needs. The purpose of the level control valve is to retard the gravity flow of liquor so as to avoid the vacuum leg effect, thus preventing air entrainment and foam.

The A press filtrate is also retarded by a level control valve, 4, to reduce air entrainment and foam. This filtrate, amounting to 328 g.p.m. is collected in the dilution tank for the blow tank.

The B press filtrate, 180 g.p.m., is retarded, 5, just as in the press ahead and this liquor also serves mostly for the blow tank dilution. However, about 40 g.p.m. is diverted to the A press chute as explained earlier.

The C press filtrate is also retarded by similar equipment and is collected in a small tank. The pumping rate of 180 g.p.m. from this tank is controlled by a pneumatic valve, 6, which holds a constant level in the tank so that its through-put changes with the variations in the wash-water quantity. This liquor is delivered by a $7\frac{1}{2}$ hp. pump for repulping at the conveyor going to the B press. All of the press filtrates contain less than $\frac{1}{2}$% fiber, but since all of the liquor reaches the thickener, it is filtered before going to the evaporators.

The water, 180 g.p.m. total, is the repulping medium of the conveyor going to the C press.

The system is entirely closed, the only losses being in the chemical taken with the pulp.

Attention is called to the low gallonage figures created by the high consistencies. The filtrate lines are 4 and 6 inches in size and the pumps are over capacity at $7\frac{1}{2}$ hp. There are only two filtrate pumps in a three-stage system.

The liquor tanks need not be large; the C filtrate tank is 11 feet in diameter by 13 ft. in height, and the dilution tank is 20 feet in diameter by 13 feet in height.

FOAM CONTROL

Since foam is generally caused by the mixture of air

ERIK ZIMMERMAN, General Supt., and HENRY VRANIAN, Chief Chemist, The Chesapeake Corp. of Virginia, West Point, Va.

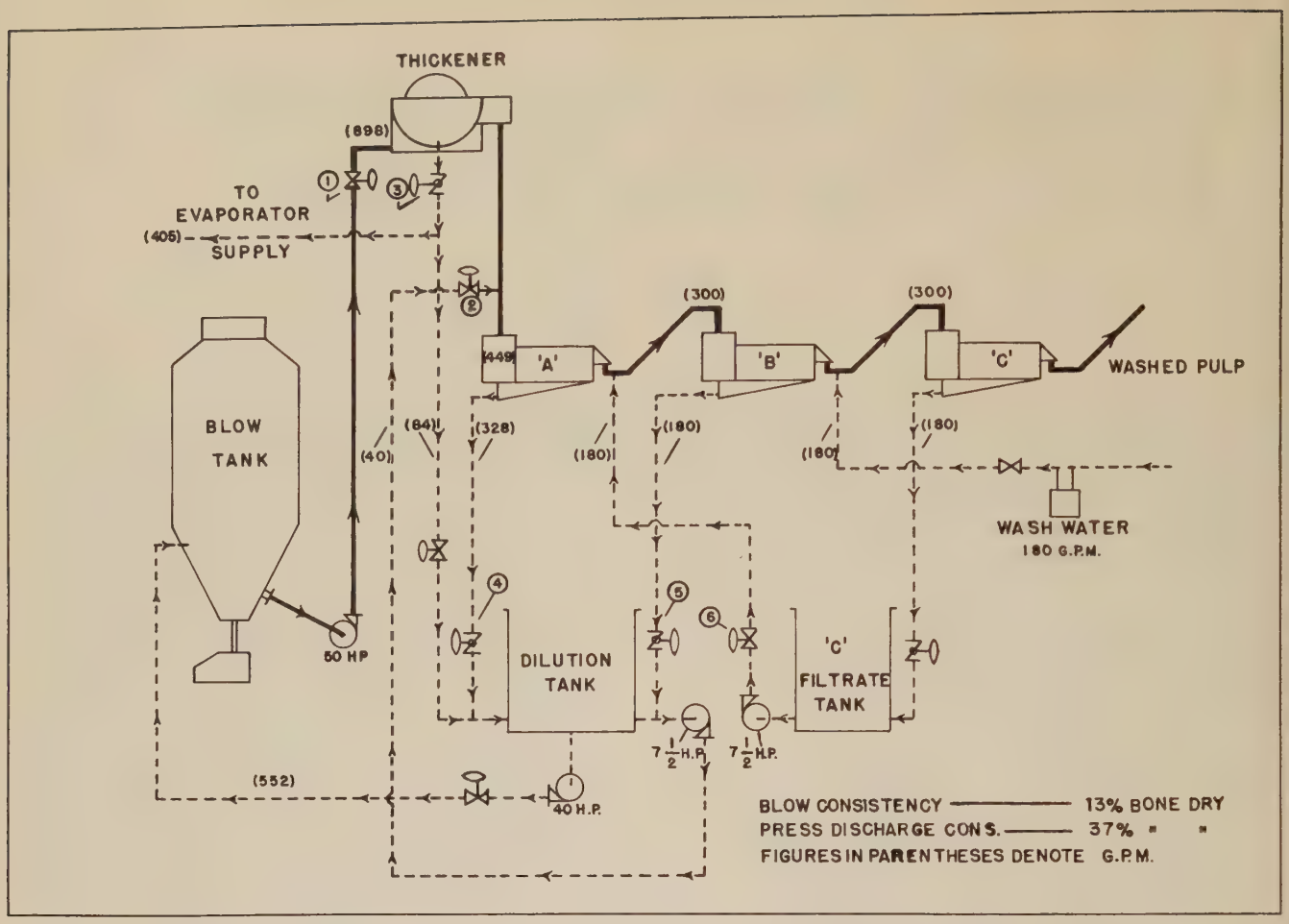

Fig. 1. A typical 300 air-dry ton three-stage pressure washing system on kraft

and liquor and because this is a pressure system, it has been possible to exclude air to eliminate foam so that no foam tanks, no foam breakers, no showers, and no defoamants are in use. To further reduce exposure to air, the pulp and liquor are in enclosed equipment. Press hoods are gasketed, conveyors covered, and, as explained earlier, additional precautions are taken to prevent vacuum which may suck air into the equipment.

DESIGN

All of the presses are designed alike, each with a compression element like a screw, down which the stock is conveyed. The trough area of the element uniformly decreases toward the discharge point while the flange diameter remains constant. The compression element, which is approximately 11 feet long, rotates in an 18-inch I.D. perforated cylinder constructed of heavy steel and well reinforced. There is a minimum of clearance between the element and the cylinder so that the cylinder is wiped clean each revolution. As the compression element rotates in the cylinder, considerable force, perhaps tons, is exerted on the pulp forcing the liquor through the perforations in the cylinder. These perforations, $^1/_8$-inch starting diameter, are tapered outward with the direction of liquor flow so that they are self-cleaning.

The compression element is made with a definite volume ratio between the feed and discharge so that the force is controlled within desired limits. Also the element and the perforated cylinder are particularly designed to lock the pulp and thus keep it from rotating, which confines the movement in a straight line to the discharge point. Consequently, the pulp does not plug or create a stoppage. The current design is entirely new and many former attempts had to be discarded because of instability. The result is a system that has been operating since November, 1949, with excellent stability and control.

The compression elements are cast iron, and the wearing area is faced with a soft nickel weld of excellent life and which can be renewed. While the present design of worms has not yet worn out, previous experience with the nickel facing promises to give a worm life of at least 100,000 tons.

The tonnage is controlled by the revolutions of the compression elements. By changing the speed, the system can be made to handle a wide range of tonnage. The extremes of the tonnage range have not been fully explored, but the present element is expected to cover a range of 200 to 300 air-dry tons. For the lower brackets a low capacity compression element may be utilized. At the present installation, one set of presses is equipped with vari-pitch sheaves. After the ideal speed for the tonnage was determined, it was not changed because of reasons stated below.

This washing system is in a mill with one paper machine and is subject to variations in tonnage from 400 to 600, depending on grades run on the machine. To accommodate such a latitude, there is a 200-ton high-consistency pulp storage tank to which the stock

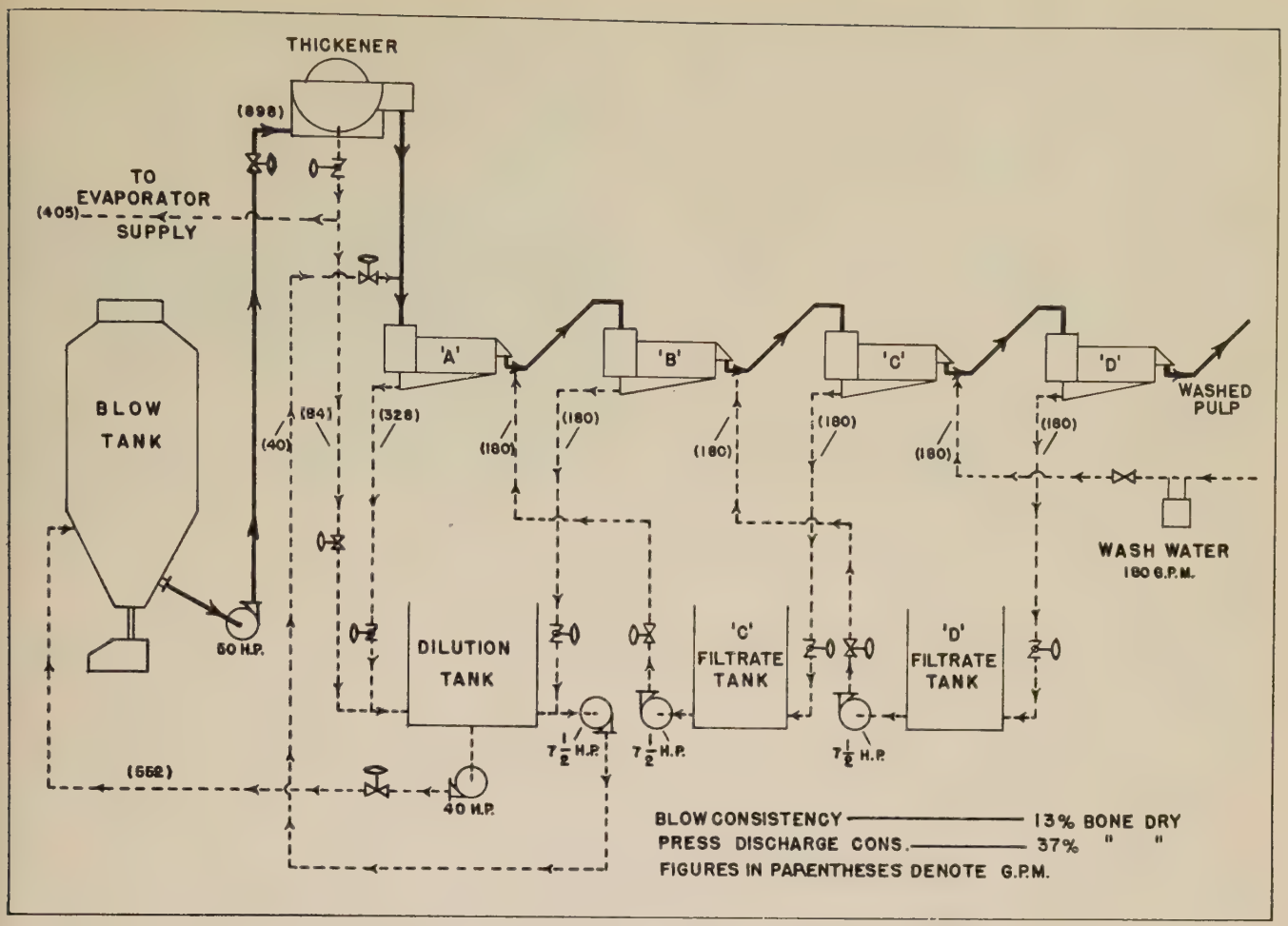

Fig. 2. A typical 300 air-dry ton four-stage pressure washing system on kraft

is conveyed directly from the last press. This tank has a cone bottom with an agitator and a consistency regulator like a blow tank. The practice is to operate the digesters, wash room, evaporators, recovery, etc., at a uniform tonnage with the tank taking the surges caused by production rate changes at the paper mill. The capacity of the tank has been a decided material factor in increasing the average tonnage of the mill and insures more uniform conditions in the rest of the pulp mill.

FUTURE DEVELOPMENTS

Since the digester blow consistency is in the range now furnished by the thickener, it is reasonable to expect that the thickener may be eliminated by a properly designed blow tank with positive feed directly to the A press.

It is possible to expand the system to four stages by adding an additional press as shown in Fig. 2. The potential gains listed below are to be weighed against the cost of the additional press.

With the four stages it will be possible to either (1) reduce the wash water, thus increasing the total solids to the evaporators, or (2) maintain the existing evaporator load and take the saving in salt cake, or (3) increase the tonnage without changing the losses and liquor density.

At the present installation the evaporators are under capacity for the new tonnage. Rather than go to the cost of increasing evaporator capacity it was deemed more economical to expand the washing system to four stages. Equipment for this development is on order.

Below are calculations showing the theoretical considerations for the proposed four-stage, 300-ton washing system under ideal conditions.

From these figures the liquor concentrations are calculated for a given set of conditions and shown on Table I.

The figures indicate that with 22% black liquor solids on blowing, the return to the evaporators will be at

Table I. Calculated Liquor Densities and Theoretical Soda with Pulp in Proposed Four-Stage Pressure Washing System

Air-dry tonnage	*300 per 24 hours*
Blow consistency, moisture-free	13%
Black liquor after blow, total solids	22%
Wash water (fresh)	180 g.p.m.
Thickener supply, moisture-free	5%
Thickener discharge, moisture-free	11%
Press discharges, moisture-free	37%

	Per cent of blow concentration	*Total solids, %*	*Theoretical pounds washable Na_2SO_4 per ton pulp*
Thickener liquor (T to evaporators)	73.7	16.2	
Dilution liquor (L)	59.4	13.1	
A press	55.6	12.2	233
B press	22.6	5.0	95
C press	8.5	1.9	36
D press	2.5	0.6	10

16.2% total solids. The soda remaining with the pulp is expressed as the washable soda and does not account for the occluded soda.

Calculations for Four-Stage Pressure Washing

Basis:

Air-dry tonnage	300 per 24 hours
Blow consistency, moisture-free	13%
Wash water (fresh)	180 g.p.m.
Thickener supply, moisture-free	5%
Thickener discharge, moisture-free	11%
Press discharges, moisture-free	37%

D Press:

Discharge 37% = 1.7 lb. D liquor per pound pulp
Feed 15% = 5.7 lb. D liquor per pulp
5.7 lb. D liquor = 1.7 lb. C liquor + 4 lb. wash water

$$\text{D concentration} = \frac{1.7}{5.7}\ \text{C concentration}$$

D concentration = 0.298 C concentration

C Press:

5.7 lb. C liquor = 1.7 lb. B liquor + 4 lb. D liquor
4 lb. D liquor = 1.19 lb. C liquor
5.7 lb. C − 1.19 lb. C liquor = 1.7 lb. B
4.51 lb. C = 1.7 lb. B
C concentration = 0.378 B concentration

B Press:

5.7 lb. B liquor = 1.7 lb. A liquor + 4 lb. C liquor
4 lb. C liquor = 1.51 lb. B liquor
5.7 lb. B − 1.51 lb. B = 1.7 lb. A
4.19 lb. B = 1.7 lb. A
B concentration = 0.406 A concentration

A Press:

9 lb. A liquor = 8.09 lb. thickener liquor (T) + 0.91 B liquor
0.91 B liquor = 0.369 A liquor
9 lb. A − 0.369 lb. A = 8.09 lb. T
8.631 lb. A = 8.09 lb. T
A = 0.937 T

Dilution Tank:

12.29 lb. dilution liquor (L) = 1.87 lb. T liquor + 7.30 lb. A liquor + 3.12 lb. B liquor
12.29 lb. L = 1.87 lb. T + 6.84 lb. T + 1.19 lb. T
12.29 lb. L = 9.90 lb. T
L = 0.805 T

Blow Tank:

19 lb. T liquor = 6.7 lb. blow liquor (K) + 12.3 L
19 lb. T liquor − 9.91 T = 6.7 K
9.09 T = 6.7 K
T = 0.737 K

SPACE

Each press (Fig. 3) is a compact unit, the over-all dimensions, without motor and pulleys, are 70-inch width by 207-inch length, and the possibilities of arrangement are flexible. For example, they may be set alongside on one floor as shown in Figs. 4 and 5B or stepped down in succession on the lower levels, Fig. 5D, or many other variations, depending on the available space, Figs. 5A, 5C, 5E, and 5F.

STABILITY

An accurate account has been kept of the down time on the presses. With the present design of compression elements, most of the lost time has been due to repacking pumps. The problem of plugging at the presses has been satisfactorily solved, and the system is taken

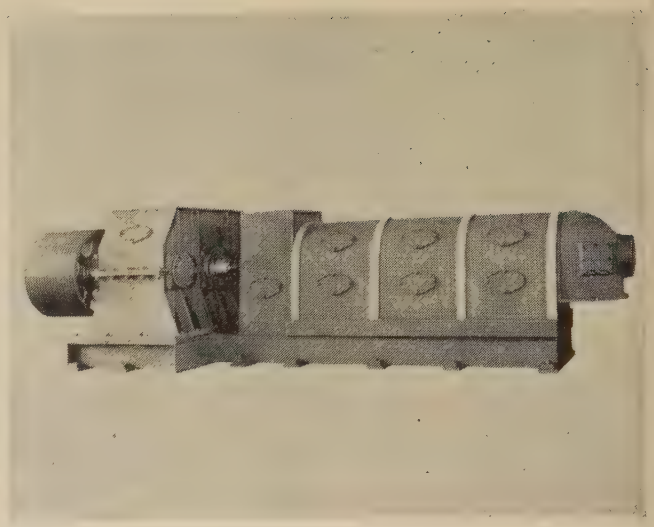

Fig. 3. Press unit

Table II. Power Consumption, Three-Stage Pressure-Washing System

Production rate	*309 air-dry tons/24 hours* Connected horsepower	Actual horsepower
Blow tank agitator	20	18
Blow tank stock pump	50	40
Large thickener	7 1/2	4
A press	125	100
B press	125	95
C press	125	95
B conveyor	5	4
C conveyor	5	4
Wash water pump No. 1	10	7
C filtrate pump	7 1/2	6
B filtrate pump	7 1/2	5
Sealing liquor	7 1/2	5
Dilution liquor	40	30
Agitators:		
dilution tank	10	4
filtrate tank	7 1/2	4
Total	552 1/2	421
Total horsepower per air-dry ton	1.7)	1.36

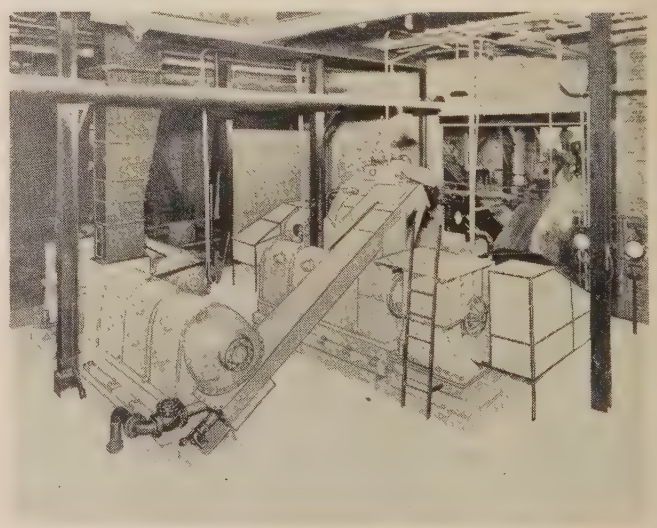

Fig. 4. A three-stage pressure washing installation on kraft

The pulp passes through "A" press (at left) up inclined screw conveyor and through "B" press (at center) and through another conveyor at "C" press in rear.

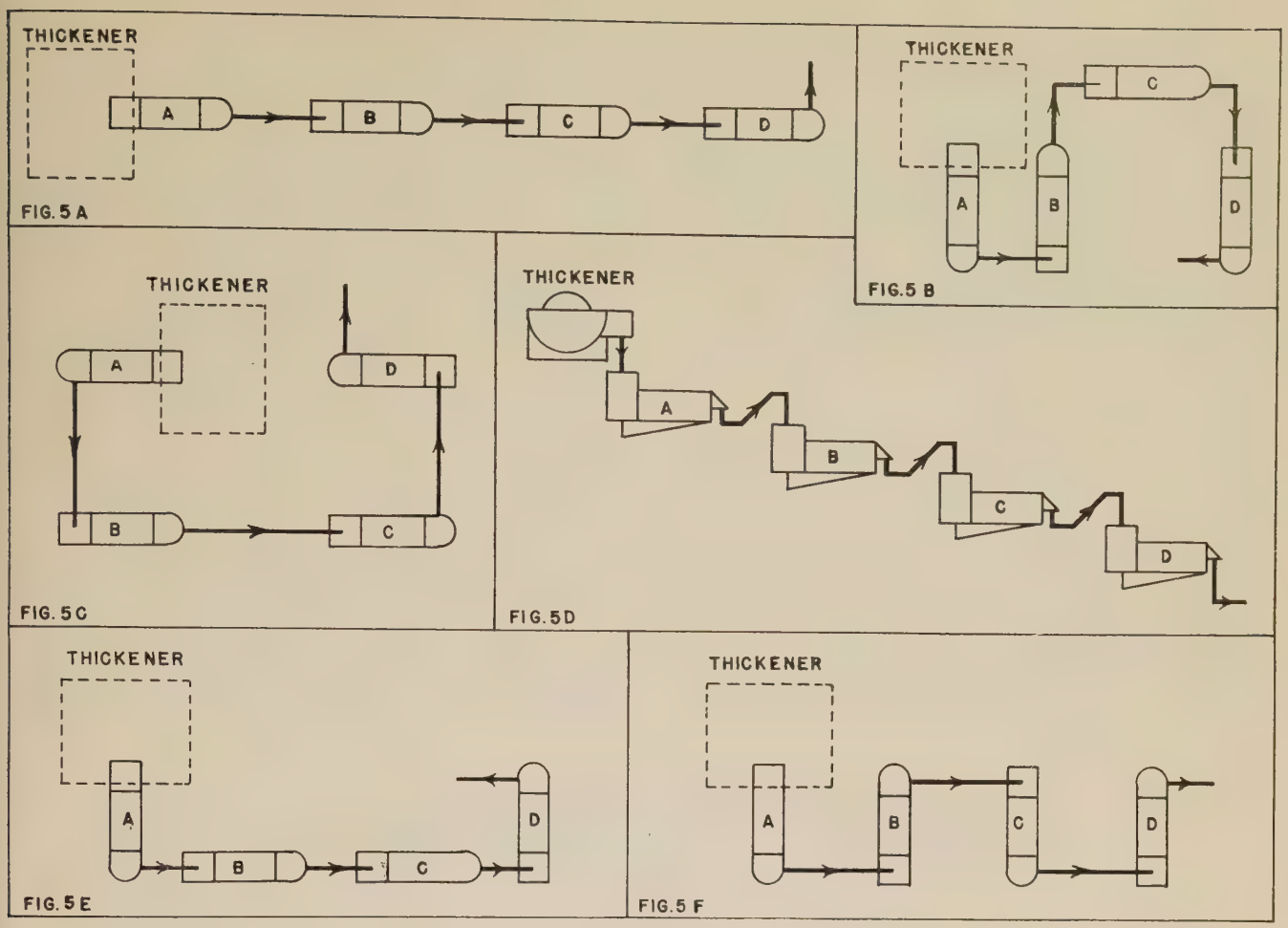

Fig. 5. Some possible arrangements of presses

on and off the line without operating difficulties. On start-ups the system is on the line fully loaded, in 3 to 5 minutes.

POWER

The power requirement for the system is given in Table II. The summation shows that the entire connected horsepower, including the blow tank, is 1.79 hp. days per air-dry ton for a three-stage system. The actual horsepower consumed is 1.36 per air-dry ton. A major factor in power saving is the low-pumping gallonage created by the high consistencies.

With the proposed four-stage system at the present tonnage, it should consume 1.71 hp. per air-dry ton.

HEAT ECONOMY

Since this washing system does not employ vacuum, it can be advantageously operated at high temperatures, permitting improved recovery of the blow heat. Wash-water temperatures have been as low as 160°F. but now exceed 200°F., with consequent increase in black-liquor temperature to the evaporators.

Fig. 6. Photomicrograph of diffuser washed kraft pulp

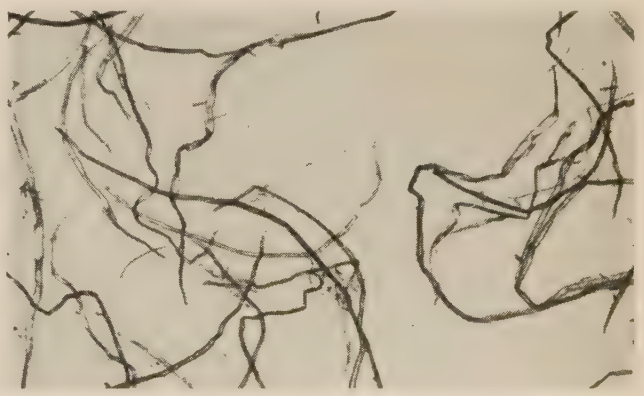

Fig. 7. Photomicrograph of pressure washed kraft pulp. Note kinking of some fibers

POSSIBLE WORK ON FIBERS

Figure 6 is a photomicrograph of diffuser washed

pulp to be compared with Fig. 7 of pressure washed pulp, both cooked in the same digester room on the same day. It can be observed that there is definite indication of some fiber kinking on the pressure-washed pulp.

The question has been raised as to whether the power applied to the presses contributes to the strength development of the pulp. This is not unreasonable to expect, because of the intense pressure and rubbing action in the presence of hot black liquor.

The usual freeness and handsheet tests are not conclusive. From the fiber appearance and the experience at the paper mill, the opinion is that some gain is realized.

WASHING OF UNCOOKED KNOTS

In the conventional continuous washing systems, considerable black liquor remains in the uncooked knots after the pulp is washed. This is evident by a circle of black liquor around the knot when a handsheet is pressed.

In the pressure system, the force of a 125-hp. drive is imposed on the knots with each pass through the presses, so that the liquor content is greatly reduced. Furthermore, since the uncooked material is delivered so that it can be satisfactorily screened and refined, it is not necessary to preknot before washing. As a result, a measure of increased yield is obtained.

WATER USAGE

Attention is called to the low-water requirement which particularly suits a mill of limited water supply. The total wash water for a 300-ton system is less than 200 g.p.m., and in this mill, it is the tail water from the screens.

It stands to reason that with less water used, there is less effluent to the sewer. Also, since the pulp is delivered at 37% consistency, a demand is created for the surplus screen water which would ordinarily be sewered. This arrangement provides some relief with regard to stream pollution.

SUMMARY

It has been shown that pressure washing of kraft board pulp has been successfully developed to provide a safe operation with a minimum usage of water and with savings in power, heat, and space.

An existing three-stage system and a proposed four stage system have been described.

Received Nov. 6, 1950. Presented at the Alkaline Pulping Conference sponsored by the Technical Association of the Pulp and Paper Industry, Jacksonville, Fla., Oct. 25–27, 1950.

Refining of Groundwood Rejects

C. T. ROBINSON

During the last 15 years, the conversion of coarse groundwood rejects, by refining to acceptable pulp for newsprint furnish, has resulted in a large decrease in waste of wood fiber.

To obtain data on the operation and maintenance of the variety of equipment available for this purpose, a questionnaire was submitted by the Mechanical Pulping Committee of the Technical Section, Canadian Pulp and Paper Association, to a fairly representative group of newsprint mills. The response was very gratifying and has resulted in the presentation of this paper before the Mechanical Pulping Conference sponsored jointly by TAPPI and the Technical Section, Canadian Pulp and Paper Association.

It is unfortunate that time was not available to enlarge the scope of this investigation. It is realized that not all types of refining equipment are represented here but since this paper was presented to promote discussion, persons having had experience with other refiners are urged to provide additional information.

Data obtained are tabulated in Tables I and II, and a copy of the questionnaire will be found in Appendix A.

WATER SEPARATORS

Since for most refiners the control of stock consistency to inlet is of prime importance, information on water separators also was obtained (Table I).

Of the sixteen mills reporting: two are operating without water separators, one with spiderless cylinder, one with scraper thickener, four with inclined wire savealls, four with deckers, and seven with Haugs. They all report operation as satisfactory. Maintenance is satisfactory except for mill 3 which is fair and mill 15 where improvements are to be made. Only other dissatisfaction is in respect to cleaning at two mills; one operating a Haug and the other an inclined wire.

Inlet consistency varies between 0.2 and 1.5% moisture-free while outlet consistency varies between 3.15 and 16% moisture-free.

Variations of outlet consistencies with respect to types are as shown in Table III.

Although of little value, since variations in consistencies are subject to operating requirements, for those mathematicians who like to know the mean, the average has been computed in the right column.

REFINERS

Data have been tabulated in Table II on the operation and maintenance of 46 refiners of seven different types as follows: one Jones, one Claflin, one Canadian Allis-Chalmers, two Sutherlands, four Noble and Woods, ten Haugs, and twenty-seven Bauers.

Since all newsprint mills could not be approached in the time available it must not be inferred that the number tabulated is indicative of the popularity of the types.

Tonnage capacity of mills are representative from 35 to 720 tons per day. Refining power per ton of total groundwood production of No. 1 pulp varies between 0.047 to 3.5 hp. per day. All mills return refined stock to newsprint furnish with the exception of two which use

C. T. Robinson, Consolidated Paper Corp. Ltd., Shawinigan Falls, P.Q.

Table I. Water Separator

Mill No.	Type	Manufacturer	Size	Number units per refiner	Stock consistency, % moisture-free Entering	Leaving	Showers: Size	Number	Pressure, p.s.i.	Location	White water	Fresh water	Steam	Comments
1	Haug	Canadian Ingersoll Rand	6 ft. 6 in. × 21-in. diam.	1	0.75	14	3/4 & 1 1/2 inches	1	...	Outside	...	Yes	...	Operation and maintenance satisfactory.
2	Haug	Canadian Ingersoll Rand	No. 3	1	0.456	10.92	...	...	...	...	...	...	...	Operation and maintenance satisfactory.
3	Oliver decker	E. Long. Ltd.	400 sq. ft.	1 for 5 refiners	0.2	7	50 gal/min.	...	90	...	...	Yes	...	Operation satisfactory. Maintenance fairly satisfactory. Vacuum discharge method of pulp removal not very satisfactory.
4	Decker	Waterous	8 × 4 ft. diam.	1 and 2	0.5	7	...	...	...	...	...	...	...	Operation and maintenance satisfactory.
5	Haug	Canadian Ingersoll Rand	7 tons	1	0.7	16	1/2 inch	3	60	Outside	...	Yes	...	Operation and maintenance satisfactory. Plugging at outlet feeding refiner. Flushing water used.
6	Scraper thickeners	Own	30 × 48 inches	1	0.8 to 1	4	...	...	...	...	...	...	...	Operation and maintenance satisfactory. Requires too much space.
7	...	...	...	...	...	...	...	...	...	...	...	...	...	Saturated chips fed to refiners by screw feeder.
8	...	...	...	...	...	...	...	...	...	...	...	...	...	.....
9	Decker	Converted wet machine	Length, 113 inches Width, 72 inches Height, 54 inches	1	0.59	4.47	1/4 inch	1	45	On cylinder	Yes	...	..	Operation and maintenance satisfactory.
10	Haug	Canadian Ingersoll Rand	No. 3	1	0.4	11.9	1 1/2 inches	2	45	...	Yes	...	...	Operation and maintenance satisfactory. Iron parts should be replaced or covered with copper to reduce clean-up costs.
11	Haug	Canadian Ingersoll Rand	No. 3	1	0.7	15	1/2 inch	2	30	Each side perfor. screen	...	Yes	...	Operation and maintenance satisfactory.
12	Inclined wire	Own	...	...	...	...	...	...	...	...	...	...	...	.....
13	Inclined wire	Unknown	Length, 103 inches Diam, 48 inches	1	0.3	13	1/4 inch	20	40	Outside	...	Yes	...	Operation and maintenance satisfactory.
13	Inclined wire	Own	65 × 50 inches	1	1	5	...	...	...	...	...	...	...	Operation and maintenance satisfactory. Requires too frequent cleaning.
13	Spiderless cylinder	Gaara	4 × 8 ft.	2	0.254	6.05	...	...	...	...	...	...	...	Operation and maintenance satisfactory.
14	Haug	Canadian Ingersoll Rand	No. 3	1	0.53	9	3/4 inch	2	10	...	Winter only	Summer only	...	Operation and maintenance satisfactory.
15	Decker	Sherbrooke	16 tons per unit	2	0.608	8	...	1	...	In pond	Yes	...	...	Operation satisfactory. Equipment to be improved.
16	Haug	Canadian Ingersoll Rand	No. 3	1	1.5	16	3/4 inch	2	30	Outside	...	Yes	...	Operation and maintenance satisfactory.
2	Inclined saveall	Own	4 × 10 ft.	1	0.30	3.15	...	...	...	...	...	...	..	Operation and maintenance satisfactory.

Mill No.	Type	Manufacturer	Size	Number of units	hp./unit	Speed	Type of plates or filler	Av. life of plates (oper. days)	Showers						Total tons grwd. prod. No. 1 pulp/day	Refining power/ton of total grwd. prod. hp./day	% Ref. stock retd. to grwd. system
									Size	Number	Pressure	Location	White water	Fresh water			
1	Haug 3 roll	Can. Ing. Rand	Liner 2 ft. 10⅝ inches × 18 inches diam.; rolls 34 inches × 5 inches diam.	2 oil and 2 water lubricated	50	290	3½% nickel steel	Liners 225; rolls 175	..	..	..	..	..	..	290	1.395	100
2	Haug	Can. Ing. Rand	Rated capacity—5 tons/24 hr.	1	60 hp. motor V-belt drive	326	6 steel spiral grooved rolls	35	..	..	35	..	..	..	520	0.98	100
3	Bauer	Bauer Bros.	36-inch disks		300	1200	B-980 metal	75	..					Plug wiper	590	2.54	75
4	Steel rotor and shoes	Noble & Wood	26 inches rotor diam.	2	800	1800	Steel rotor. Cast iron shoes	Shoes and rotors (per cut) 48	..	..	..	..	On seals	..	415	3.50	100
5	Haug	Can. Ing. Rand	7 ton	2	50	325	Grooved rolls and grooved shell	Rolls 1 yr.; shell 2 yr.	..	..	...	..	..	..	240	0.4	100
6	Bauer	Bauer Bros.	36 inch	3	1–200; 2–300	2–900; 1–1200	Cast	75	.	..	..	..	..	..	405	2.0	100
7	Bauer	Bauer Bros.	15 tons per day	6	300	1200	Plates	18	¼ inch	7	50	3 chutes 4 case	2	4 water heated to 130°F.	120	No record	...
8	Jones high speed	E. D. Jones & Sons	No. 1	1	40	1200	Norton stone	Not known	..	..	..	..	..	..	35	0.047	100
9	Rotor and shoes	Noble & Wood	Rotor—26 inches diam. × 12 inches wide	1	200–800	1780	Rotor—0.40 carbon steel annealed forgings; shoes—gray cast iron	Rotor and shoes 30	..	..	..	..	..	..	310	2.2	100
10	Haug	Can. Ing. Rand	No. 2 type 4	1—6 roll; 1—3 roll	60	340	Ch Ni steel liners—solid not grooved	1–297 days. No average	..	..	..	..	..	..	241	.	100
11	Bauer	Bauer Bros.	36 inch	6	300	1200	9B-01 cast gray iron	60	½ inch	4	30	2 each side of disk casing	No	Yes	720	2	Refiner screen rejects to board machine
12	Claflin	Hermann Mfg.	...	1	125	514	Norton abrasive	2–4 yr.	..	..	..	..	..	..	60	2 03	100
13	Rotating disk	Bauer Bros.	40 inches diam.	1	300	1455	B-980	90	..	..	..	..	..	..	445	0.637	0
13	Rotor shoe	Noble & Wood	25½ inches diam.; rotor —11¾-inch face	1	650	1475	Metal—grooved rotor and cast iron shoe	Rotor—6 mo.; shoes—2 mo.	..	..	..	..	..	..	445	1.46	100

Operation Survey
Based on Air-Dry Tonnage)

Final disposition of refiner stock			Rejects refined				Rejects shredded before refining	Stock freeness, ml.		Operation of refiners		Cost in cents per ton total grinder production				Comments
Newsprint	Board	Spec.	Bull scrns.	Knotter scrns.	Fine scrns.	Other		Entering	Leaving	Parallel	Series and no. of stages	Oper. matl.	Oper. labor	Main. labor	Main. matl.	
Yes	No	No	Yes	No	Yes	No	Bull screens only	725	375	Yes	..	1.7	1.1	2.8	0.7	Operation satisfactory. Maintenance satisfactory on water lubricated but it is too high on oil lubricated.
Yes	No	No	No	No	Yes	No	..	730	225–300	..	..	..	..	1.3	1.8	Operation satisfactory. Maintenance satisfactory except some liners have broken at edges. Machine requires considerable maintenance. Rolls are machined and grooved often—Cast body is ground in large lathe. *Note re Showers:* four steam jets in feed spout. Air shot into main housing for better agitation through central shaft. This mill also operates two Bauer refiners in wrapper mill on mixed stock (sul. & grwd.) with good results.
Yes	..	..	..	..	..	..	No	700	400	Yes	.	Refiners only in operation few months—no reliable data as yet				Stock to refiners is accepted stock from secondary screens. Operation not very satisfactory due to necessity of operating at 4.5 to 5% consistency to obtain steady load on refiners. Improved feed arrangement would allow higher consistency with much better results. Refiner maintenance is fairly satisfactory.
Yes	..	..	Yes	Yes	..	Re-screens	Bull screen rejects	650	300	..	Yes—2	2	2	6	7	Operation and maintenance satisfactory.
Yes	..	..	Yes	Cowan screen rejects	..	Sulphite knots and knotter rejects	Sulphite knots and bull screen rejects	700+	500+	Yes	..	.. Based on operation of 3 months	5	3	2	Maintenance and operation not satisfactory. Refiners are overloaded—should refine to around 180 freeness, but operating above 500—water added to inlet may be partly responsible. Although moved to a more solid foundation, with six rolls in a refiner, the journals are breaking as well as bolts holding cover on casing.
Yes	Yes	..	No—grind in magazines	Yes	Yes	Old paper mill cores	No—only cores—3 Berkshire refiners in series handle all stock before going to Bauers	700	300	Bauers only	3 Berkshires	1.1	0.06	3.8	4.6	Double revolving disk pulper. Operation and maintenance satisfactory.
..	Yes	..	..	..	..	Cooked chips	No	..	650	Yes	..	0.17	0.50	0.08	0.06	Operation and maintenance satisfactory. For about one year six Bauers have been operated to convert cooked chips from mixed wood to corrugating board. The stock is then passed through two Claflin refiners for a final brushing before going to board machine. Believed to be only installation of this kind in Canada.
..	..	Yes	No	No	Yes	..	No	700	520	..	..	No information available, see comments				Refiner in operation only since April 30th, 1948—operation satisfactory—no maintenance to date.
Yes	..	..	No	Yes	Yes	No	Knotter screen rejects jordaned	810	593	..	..	0.26	8.32	..	1.5	Operation reasonably satisfactory. Maintenance costs too high—does good job with minimum fines.
Yes	..	..	No	No	Yes	Sulphite 2nd stage fine screen	No	500–600	170	Yes	..	..	2.6	4.7	8.7	Operation satisfactory, but produces large percentage of fines. Maintenance not satisfactory—bearing failures cause high maintenance costs. Rolls need regrinding and regrooving frequently—liners were bolted to housings but are now being welded to shell to try to increase life and period between grindings.
Yes	Yes	No	Yes	Yes	Yes	No	Bull screens only	700	400	Yes	No	..	..	..	..	Two rotating disks. Operation and maintenance satisfactory.
..	..	Yes	No	No	Yes	No	No	700	675	..	..	..	..	..	..	Operation not entirely satisfactory. Quality of work good—capacity low. Does reasonable job for requirements. Maintenance satisfactory.
No	Wrapper	..	Yes	Yes	..	..	Bull screens only	Too free to test	610	..	..	..	5.4 (See note)	0.3	0.3	Operation and maintenance satisfactory but capacity not quite high enough for requirements. *Note:* Maintenance labor and material shown as cost per ton of groundwood refined.
Yes	..	..	..	Sulphite	Yes	..	No	740	441	..	..	..	5.4 (See note)	0.3	0.5	Operation and maintenance satisfactory but insufficient capacity for tonnage handled. *Note:* Maintenance material and labor shown as cost per ton of groundwood refined.

Table II. Refiner

Mill No.	Type	Manufacturer	Size	Number of units	Hp./unit	Speed	Type of plates or filler	Av. life of plates (oper. days)	Showers: Size	Showers: Number	Showers: Pressure	Showers: Location	Showers: White water	Showers: Fresh water	Total tons grwd. prod. No. 1 pulp/day	Refining power/ton of total grwd. prod. hp./day	% Ref. stock retd. to grwd. system
13	Cone plug	Can. Allis-Chalmers	61⅛ inches length; 37¼ inches large end; 16¼ inches small end	1	0.350	375	Metal bar type	18 mo.	..	..	..	..	..	..	445	0.745	100
14	Haug type 4 No. 1651-L	Can. Ing. Rand.	6 roll—size 2—7 ton	1	48	330	6 steel spiral grooved rolls	3½ yr.—both rolls and liners	⅛ Buffalo	2	40	Feed spout to refiner	No	Yes	165	0.30	100
15	Single rotating disk	Sutherland	42 inch	2	450	600	316 Stainless	2 mo.	..	..	..	..	..	..	500	¾	88
16	185	Bauer Bros.	36 inch	5	300	2–900; 3–1200	B-993	57	½ inch	1	10	Inlet	Yes	..	620	1.3	100
2	Bauer	Bauer Bros.	No. 165 36 inches diam. Serial B-980	1	75	1760	Cast iron alloy	134	..	..	35	..	..	2 jets on side	520	1.38	0

it in the manufacture of specialties and five mills which use it in board or wrapper.

Bull screen rejects are shredded and refined at six mills only. All mills evidently refine the fine screen rejects.

Since knotters are not operated at all mills, it is difficult to make an observation on this point.

Six mills are refining sulphite tailings, while one is refining old paper mill cores.

Stock freeness before refining ranges from 350 (Canadian Standard) up, with the majority in the vicinity of 700. After refining, it varies between 170 and 687. Only two mills are operating refiners in series. One mill operates a refiner on bull screen rejects as a pre-refiner.

An interesting comparison of types of refiners returning all the refined stock to newsprint furnish is shown in Table IV.

GENERAL COMMENTS AND OBSERVATIONS

The writer is of the opinion that the comments of mill 7 are well worth stressing in that cooked chips are converted to make corrugating board.

Operation of all types would appear to be reasonably satisfactory. However maintenance problems are present in many cases as is indicated in Table II.

It would be impossible to consider this portion as complete without expressing appreciation to the managements of the participating mills for their splendid cooperation in supplying so fully and promptly the material which made this paper possible.

Table III. Outlet Consistencies

Type	Consistency range, % moisture-free	Average consistency, % moisture-free
Decker	4.47 to 8	6.6
Haug	9 to 16	13.3
Inclined wire saveall	3.15 to 13	7
Scraper thickener	...	4
Spiderless cylinder	...	6.05

APPENDIX A. REFINER OPERATION SURVEY QUESTIONNAIRE

SECTION I

WATER SEPARATOR

1. Type
2. Manufacturer
3. Size No. of units/refiner
4. Stock consistency, % moisture-free—Entering
   —Leaving
5. Showers: Size Number Pressure
   Location
   White water Fresh water
   Steam
6. Is operation satisfactory?
7. Is maintenance satisfactory?
8. What features do you deem unsatisfactory?
9. Comments:

SECTION II

REFINER

1. Type
2. Manufacturer
3. Size
4. Number of units
5. Horsepower per unit Speed
6. Type of plates or filling Metal
   Other
7. Average life of plates (operating days)
8. Showers: Size Number Pressure
   Location
   White water Fresh water
   Steam
9. Total grinder production of No. 1 pulp per day
10. Refining power per ton of total grinder production (hp./day)
11. What per cent of refined stock is returned to groundwood system?
12. What is final disposition of refiner stock?
    Newsprint?
    Board?
    Specialties?
    Other?

Operation Survey (*continued*)

Final disposition of refiner stock: Newsprint	Board	Spec.	Rejects refined: Bull scrns.	Knotter scrns.	Fine scrns.	Other	Rejects shredded before refining	Stock freeness, ml.: Entering	Leaving	Operation of refiners: Parallel	Series and no. of stages	Cost in cents per ton total grinder production: Oper. matl.	Oper. labor	Main. labor	Main. matl.	Comments
Yes	..	..	..	..	Yes	..	No	370	320	..	..	..	5.4 (See note)	0.4	0.5	E. D. Jones Majestic jordan. Operation and maintenance satisfactory. *Note.* Maintenance labor and material are shown as cost per ton of groundwood refined.
Yes	..	..	No	Yes	Yes—also sulphite	No	No	700	310	..	..	0.1	5	1	3	Operation and maintenance satisfactory. When refiner was installed, laminated micarta bearings were used for the rolls but were subsequently replaced by solid, no-bolt Ryertex bearings which have proved to be most satisfactory. These bearings have operated for 3 years without replacement. Installation of a head box and lithcoted inlet spout have increased uniformity of feed and reduced tendency to plug in the spout. Rolls are calipered and matched in pairs to secure the best possible running balance.
Yes	..	..	No	No	Yes	..	No	697	687	Yes	..	12	113	17	28	Maintenance not satisfactory—operation on present system satisfactory. Experimenting with above equipment since installation; at present undergoing screen and system changes, etc. Based on moisture-free tonnage of groundwood stock
Yes	..	..	Yes	..	Yes	Sulphite tailings	Bull screens only	700	350	4	1 with remaining 4 on shredded stock	0.75	1	3.3	2	Operation satisfactory. Too much trouble with bearings on maintenance—have tried both oil and grease.
No	Yes	No	No	No	Yes	No	..	727	650–650	..	..	..	..	3	2	Two disks revolving in opposite direction. Operation satisfactory—machine has given considerable bearing trouble. Machine is of early design and speeds are high which may account for trouble.

Table IV

Refiner	Mill No.	Number of units	Refining power/ton of groundwood production hp./day	Freeness: Entering	Leaving	Operation and maintenance cost/ton, cents	Remarks
Bauer	16	5	1.3	700	350	7.1	Operation satisfactory. Maintenance unsatisfactory.
Canadian Allis-Chalmers	13	1	0.745	370	320	6.3[a]	Operation and maintenance satisfactory.
Haug	1	4	1.395	725	375	6.3	Operation satisfactory on water lubricated. Maintenance unsatisfactory on oil lubricated.
Haug	2	1	0.98	730	265	3.1[b]	Operation and maintenance satisfactory.
Haug	5	2	0.4	700	500	10[c]	Maintenance and operation unsatisfactory.
Haug	10	2	0.5	550	170	16[d]	Operation satisfactory. Maintenance unsatisfactory.
Haug	14	1	0.30	700	310	9.1	Operation and maintenance satisfactory.
	Weighted average	(10 units)	0.9	685	340	6.9[e]	
Noble & Wood	4	2	3.50	650	300	17	Operation and maintenance satisfactory.
Noble & Wood	9	1	2.2	810	593	10[f]	Operation reasonably satisfactory. Maintenance unsatisfactory.
Noble & Wood	13	1	1.46	740	441	6.2[g]	Operation and maintenance satisfactory.
	Weighted average	(4 units)	2.7	710	410	17[h]	
Sutherland	15	2	0.68	697	687	153	Operation satisfactory. Maintenance unsatisfactory.

[a] Cost shown as per ton of refined stock and does not include operating material cost.
[b] Excluding operating labor and operating materials costs.
[c] Excluding operating material costs and based on three months operation.
[d] Excludes operating material costs.
[e] Based on data from mills 1 and 14 only.
[f] Excludes maintenance labor costs.
[g] Cost shown as per ton of refined stock and excludes operating material costs.
[h] Based on data from mill 4 only.

13. Do you refine? Bull screen rejects
Knotter screen rejects
Fine screen
Other
14. Before refining, are rejects shredded? Other?
15. Stock freeness (Canadian Standard): Entering
Leaving
16. Do your refiners operate in parallel? Series
If the latter, how many stages?
17. What is cost per ton of total grinder production for:
Operating material? Operating labor?
Maintenance labor? Maintenance material?
18. Is operation satisfactory?
19. Is maintenance satisfactory?
20. Comments:

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Selection of Electric Motors for Paper Mill Application

A Preliminary Report of the TAPPI Electrical Subcommittee

R. F. SORENSON, W. V. KNIGHT and R. W. FOSTER

Electric motors form the heart of the motive power in a pulp and paper mill. To provide a maximum of reliability, motors must be judged as to type of enclosure, insulation of the windings, type of bearings, and their designed operating characteristics. Standardization of motors is of prime importance for simplified spare parts inventory, however, there are many special applications where a motor must be selected to suit the individual problem. Where there is a special application problem, thought must be given to the various equipment available and final selection made to suit the individual mill.

At the present time there is very limited information available in combined form that can be used as an aid in selecting motors for use in a pulp and paper mill. The purpose of this paper is to present the views of the TAPPI Electrical Subcommittee in the selection of motors throughout the mill. The paper machine itself and the rewinders were not covered by the committee. This report should be prefaced "preliminary" as it is certain that much can be added to it by other mills and manufacturers represented here. We want to encourage both oral and written comments on the paper. We believe that this project on motor selection should be continued on through the coming year so that it can be fully developed by taking advantage of the criticisms and suggestions that will be offered. The section of the report dealing with special application should be expanded to include a greater variety of equipment.

The paper does not pretend to cover every detail of motor application or to be the final judgment of any particular application, but rather is intended to present a view of the problems involved and some possible solutions. The existing conditions at the point of application of a motor vary greatly and the final selection must be made to suit the individual mill.

MOTOR CHARACTERISTICS

A pulp and paper mill presents some of the most difficult application problems that can be found in any industry. Motors are subjected to temperature extremes, very wet locations, abrasive atmospheres, and corrosive fumes, and are expected to operate 24 hours a day with an absolute minimum of trouble. This means that much care must be taken in selection of these motors. The whole mill feels the impact of a motor failure through the resulting loss of production and the department that is charged with this loss is the electrical maintenance department and its head, the chief electrician. He will judge a motor from the four following essentials: (1) enclosures, (2) insulation of the windings, (3) bearings, and (4) design characteristics.

Enclosures

The chief electrician wants a motor winding to have the greatest protection possible against moisture, abrasive dust, and acid or alkaline chemicals or their fumes. The more complete the protection the better chance the winding has for a long life. The most complete protection is offered in T.E.F.C. (totally enclosed fan cooled) motors. Many mills have adopted the practice of purchasing all squirrel-cage induction motors with T.E.F.C. enclosures, for all applications except where they are ruled out by price considerations. This would mean that T.E.F.C. motors would occasionally be applied in locations where an open motor would suffice. This procedure has a definite advantage in the stock of spare motors. If the plan were to be followed out completely it would mean that the stock of spare motors would always have a motor with the proper enclosure for the most difficult application in the mill. It is not an uncommon thing to find that the spare motors in a mill have shifted so that only an open motor is available to replace a T.E.F.C. motor that has failed. From the standpoint of cost, the premium paid for T.E.F.C. motors is offset by their advantages up to about 100 hp. At this point there is a sharp increase in the price difference between open and T.E.F.C. motors. Figure 1 illustrates this point for standard squirrel cage, 1200 r.p.m. motors. Above 100 hp. it is necessary to weigh the advantages of a T.E.F.C. motor against the premium price and also against the other types of enclosure that are available. If it is deemed absolutely necessary that the motor be totally enclosed there are three other possible solutions: (1) base-ventilated motors, (2) totally enclosed externally ventilated motors, and (3) totally enclosed unit-cooled motors. (Motors incorporating an integrally mounted blower and heat exchanger.)

(1) Base-ventilated machines are less expensive than a T.E.F.C. machine, a separately ventilated machine, or a unit-cooled machine. They find their application where there is access through the floor and where there are no objectionable atmospheric condition below the floor.

(2) Totally enclosed externally ventilated machines must include in their cost the price of external blower and duct work. If there is a group of such motors located in the same area the same fan can, of course, be designed for the group and the cost per unit is decreased. The cost of the ventilating system must be determined before any price comparisons can be made. As the size of the motor increases the price of the externally ventilated machines become increasingly more favorable.

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(3) The unit-cooled motors are becoming more popular in the industry. These motors eliminate the necessity of designing an external ventilating system and provide a "package unit." Where there is just one motor involved, this system of ventilation is more economical than a totally enclosed externally ventilated motor. Again, as the size of the motor increases, its price becomes favorable over T.E.F.C. construction.

Splashproof and dripproof motors come into the picture very strongly as the size of the motor reaches 100 hp. Splashproof motors provide protection so that water can be directed at them, up to 100° from the vertical, and not get into the windings when the motor is not running. For this reason it provides better protection

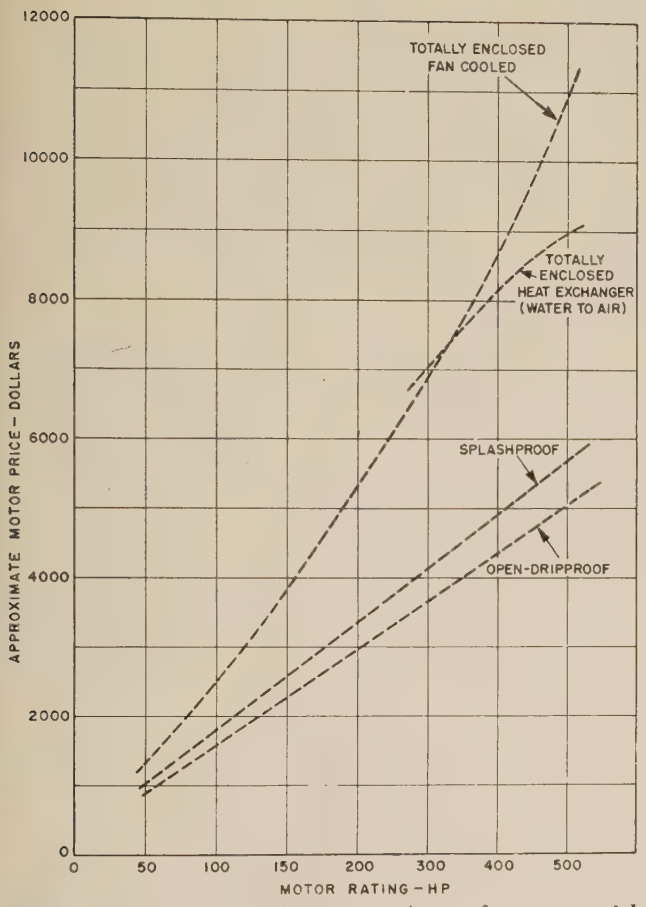

Fig. 1. Approximate price comparison of motors with different enclosures

when water is directed in at it than a dripproof motor. The ventilating air intakes of a splashproof motor are restricted, however, and this means high velocity of the intake air. This velocity can be high enough to pick up splashing water or foam and carry it into the motor windings. A splashproof motor should always be mounted on a pad off the floor when there is a possibility of it becoming surrounded with water or foam. Splashproof motors carry with them another disadvantage; the features of construction that make the motor "splashproof" also prevent blowing off the windings of the motor with air, unless the end bells are removed. This can be a distinct disadvantage when the motor is located in an area where the windings accumulate dust or foreign matter.

Dripproof is the standard motor construction that carries with it both advantages in price and availability for shipment. Dripproof construction provides nearly as great a protection as splashproof, when all factors are considered. The windings of these motors are easily blown off with air.

An item that is not directly concerned with enclosures, but applies to all motors, is that of general sturdiness in construction. The feet of the motor should be designed to take some abuse, and the end bells and coverings should be strong and corrosion resistant.

Insulation of the Windings

Class A, or organic, is the standard insulation. It is the most economical winding, and is satisfactory in most applications. Class A, insulation is based on ambient temperature of 40°C. For ambient temperatures exceeding 40°C., class A insulation may be used as long as the total temperature does not exceed 90°C. for open motors and 95°C. for enclosed motors. Class B or inorganic insulation raises these limits to 110°C. for open motors and 115°C. for enclosed motors.

Inorganic insulation is also applied where a large motor must be built in a small frame size because of space limitations. This would, of course, mean a special motor with a high-temperature rise, and a special motor must be carried as a spare. This type of application should be avoided, too, as the high operating temperatures usually mean bearing trouble.

In many mills inorganic insulation is being used on motors having a normal temperature rise of 40 to 50°C. as an insurance against overloads. A typical example is jordan motors. These motors are subject to frequent overloads, and the life of the windings has been lengthened by using inorganic insulation. We have found that class B insulation has been very satisfactory in similar applications.

Class B insulations have provided longer life and this must be weighed against the additional cost of winding to determine its advisability. Frequently an oversize class A insulated motor can be purchased for the additional cost of class B insulation.

Class B is an effective way of increasing the horsepower rating of an existing class A insulated motor in the large sizes. Class H or silicone insulation will withstand very high temperatures and is very resistant to moisture. This insulation is more susceptible to damage by abrasion. At present its cost is almost prohibitive and it is used only in very special applications. Electric truck motors have adopted this insulation as a standard.

When large motors are to stand idle for periods of time, it is desirable to install space heaters in the motor to retard moisture absorption in its windings.

Bearings

Small motors have been standardized for antifriction bearings. If these bearings are properly lubricated according to the manufacturers' recommendations, they give excellent life and require attention only every few months. Recently sealed antifriction bearings have been taking their place in industry. The manufacturers claim these bearings will need no attention for several years and then should be completely taken down, flushed, and repacked. Many mills, however, prefer

an antifriction bearing that can be flushed and regreased without removing the end bells of the motor.

On larger motors there is a choice between antifriction bearings and sleeve bearings. Antifriction bearings have a definite life that is determined by the revolutions per minute and the radial thrust. Where extremely heavy rotors are involved sleeve bearings are the more satisfactory. Sleeve bearings require more attention than do the antifriction bearings. The oil in sleeve bearings should be checked at least once a week, as there is danger of leakage or contamination of the oil by chemicals in the mill.

Characteristics

Squirrel cage motors should be selected for across the line starting, whenever possible, to realize the saving in the motor starters. Normal-starting torque—low-starting current, high-starting torque—low-starting current, or high torque—high slip motors may be selected according to the load requirements. High slip squirrel cage motors should be selected for pulsating loads where advantage is to be taken of a flywheel.

Normal-starting torque—low-starting current induction motors should be used whenever possible in the interest of standardization. When applying a high-starting torque induction motor with a high-inertia load, it should be carefully determined that the rotor has sufficient thermal capacity. When frequent starts are encountered the heat to be dissipated in the rotor may become excessive.

When both the inertia load is high and/or frequent starting is encountered consideration should be given to a wound rotor motor. In the wound rotor motor the starting torque available in the motor can be matched to the load by inserting the proper resistance in the rotor external circuit. Another advantage of the wound rotor in such an application is that much of the heat to be dissipated is taken care of in the external resistance rather than in the rotor itself.

Wound rotor induction motors may be used as a variable speed drive by varying the external resistance. The speed of the motor will vary with the load, however, and at zero load will be nearly at synchronous speed.

Synchronous motors are sometimes used because of their constant speed characteristics. The primary reason for selecting them over induction motors, however, may be because of any one of the following advantages:

1. The initial cost is lower in (a) ratings below 500 r.p.m. above 50 hp. (b) Very large horsepower rating, that is, 500 to 1,000 hp. and above at medium speeds (500 to 900 r.p.m.).
2. They operate at unity or a leading power factor thus improving the power factor of the average plant at low cost per corrective kva. supplied.
3. The efficiency of low-speed synchronous motors and unity power factor high-speed synchronous motors is higher.
4. Large air gap—two to three times that of an induction motor. This is a distinct advantage in direct connected drives particularly where the motor is furnished without shaft and bearings.
5. Lower starting current.
6. Special starting characteristics do not affect running efficiency as they do in induction motors.

Direct-current motors are used where an adjustable speed drive is necessary. The direct current may be supplied from a motor generator set and controlled by conventional means or a "packaged drive" may be selected. The "packaged drives" are becoming increasingly popular for adjustable speed drives. They provide a convenient method of obtaining adjustable speed drive from an alternating-current supply and still have the control and other equipment housed in a compact unit. They find great favor in applications where it is desirable to locate the unit near the driven machine without enclosing it in a substation. Many features are being incorporated in these units such as: current limit (torque limit), controlled acceleration and deceleration, accurate speed control, and torque control. Standardization has brought the price of these units into a range for general application.

SPARE MOTORS

Spare motors must always be kept in mind when selecting new motors. It is desirable to carry a minimum stock of spare motors and this is possible only in a plant where there is standardization of motors.

In selecting new motors it should always be determined whether it can be made a duplication of one in the mill for which there is a spare motor available. Standardization of T.E.F.C. motors in the smaller sizes insures that the spare motors will be qualified to replace any motor of similar rating in the mill.

Motors that do not have standard mountings or design characteristics should be avoided whenever it is at all possible, as these motors cannot be replaced with a standard motor from the spare stock, and a special spare motor must be carried that has only one application. It has been our experience that gear motors and other "built in" motors are not interchangeable and complicate the spare stock. While the gear motor saves space, where continuity of service and easy maintenance are vital, consideration should be given to a separate motor and gear unit as compared to a gear motor.

SPECIAL APPLICATION

Chipper Motors

The selection of a chipper motor is subject to more variations than perhaps any application in the paper mill. Recommendations must be qualified to fit the needs of the individual mill.

Synchronous, wound rotor, high-resistance squirrel-cage, and straight squirrel-cage motors are all used, and each has its proper application. The horsepower required for a given application is beyond the scope of this paper and the manufacturers should be consulted.

A synchronous motor gives constant speed chipping. Since the cost per horsepower of a synchronous motor is less at lower speeds the motor is usually directly connected. This also eliminates belts and pulleys with their maintenance difficulties and possible safety hazards. Since a synchronous motor runs at a constant speed little use can be made of the flywheel effect of the chipper rotor. This means that large peaks of power must occur to hold speed as the logs come in contact with the chipper knives. If the mill power plant is small these load peaks will cause excessive variations in frequency and voltage. Large power plants will be able to carry these peaks. The constant speed characteristic has the advantage of allowing the supply of wood to the chipper to be relatively unregulated,

that is, the chipper will continue to do its job as long as the maximum pull-out torque and temperature rise are not exceeded.

Synchronous motors, of course, require a source of d.c. power for excitation and its starting control is relatively complicated and expensive. The motor should be rated 0.8 lead power factor as it will go to 0.8 lag on peak loads. A pull-out torque from 250 to 300% is most generally used and a starting torque of 50% and pull-in torque of 60%. The amortisseur winding must have sufficient thermal capacity to absorb the entire stored energy in the revolving elements.

The high-resistance squirrel-cage motor is less expensive at higher speeds and is therefore generally belted. Belts and pulleys are additional maintenance items and can be safety hazards. Belting the motor does eliminate the problem of positioning the rotor in the stator, as it is independent of the chipper rotor. The large air gap in the synchronous motor, however, minimizes this problem. The control for a squirrel-cage motor is simple and relatively inexpensive for across the line starting. If the power supply is small, however, it is probable that reduced voltage starting must be used. Starting torque is about 125% rated and its maximum torque will be approximately 250%.

The wound rotor motor can be used either belted or directly connected. Its control is more expensive than either the synchronous or squirrel-cage control. Its starting torque is controlled by the resistance inserted in the secondary circuit of the motor. Starting torque is usually set up for about 150%. The wound rotor motor is the easiest on the power supply frequency and voltage.

The purpose of using a squirrel-cage or wound rotor motor is to take advantage of the flywheel effect of the rotating parts, thereby minimizing the peak loads. When these motors are belted and thus running at higher speeds the flywheel effect of the motor rotor is greater than if they are directly connected at slow speed. With the wound rotor the optimum resistance can be left in the rotor circuit to get the best operating characteristics. It is essential, however, that the logs be so regulated that the chipper will have time to recover its speed sufficiently after a period of cutting. For this reason, it is not advisable to use a high-resistance squirrel-cage or wound rotor motor of less horsepower than is required for load conditions, unless a sacrifice in production can be made in loss of time required to accelerate the motor back to speed.

Chipper motors are subject to mechanical damage of flying wood chips or falling sticks of wood. The enclosure of the motor should be "fully protected and dripproof." Sawdust accumulation in the windings and air passages is always a problem, and some chipper motors have been installed totally enclosed and externally ventilated. The terrific shock loads encountered in the chipper operation call for a much heavier construction than standard motors. The motor windings should be thoroughly braced to withstand shock loads.

Antifriction bearings are generally supplied by the chipper manufacturer for direct connected motors. Belted motors may have either sleeve or antifriction bearings.

Class A insulation is most generally used.

Conveyor to Chipper

This conveyor motor is subjected to severe starting duty. In some mills this motor is started and stopped up to 60 times an hour.

Since this conveyor feeds logs to the chipper it must be regulated by some means to govern the flow of logs in order not to overload the chipper or jam the chipper spout. This can be done by a variable speed drive or by continually stopping and starting the conveyor and using a constant speed motor. If the latter method is used this motor will be subjected to very frequent stops and starts. This very heavy starting duty makes the selection of the motor difficult. We have found that a high-resistance rotor is not suitable in this application because the frequent starts call for too much heat to be dissipated in the rotor. Overmotoring is disappointing in an application with frequent starts because starting currents increase the motor size. Another difficulty experienced in this motor is damage due to the mechanical shocks from repeated starting. A formed rotor winding, rather than a random winding, is more able to withstand these repeated shocks.

To ease the starting duty a hydraulic coupling can be used. This coupling must be selected by taking into account its thermal capacity for this starting duty. Variable speed drives for this application are becoming more common. With a variable speed drive the flow of logs can be regulated so that the number of complete stops can be reduced materially. Wound rotor motors using continuously rated resistors have been very successfully applied. Direct-current "package" units are also being used. With these units advantage can be taken of controlled acceleration and current limit, as well as variable speed.

Standard squirrel-cage motors can be applied with a variable speed coupling such as a magnetic clutch or a variable speed hydraulic coupling. The conveyor is more than a constant torque load so the coupling must be designed for this to handle coupling speed operation without overheating.

To have this conveyor run continuously is, of course, not possible until the flow of logs to the conveyor is also regulated and coordinated with the chipper itself.

These motors are subject to accumulation of sawdust and dirt. For a.c. motors a T.E.F.C., ball-bearing motor is recommended. When starting duty is severe, a totally enclosed externally ventilated motor should be used to better remove the excess heat. Direct-current motors should be enclosed externally ventilated if possible. T.E.F.C. motors cannot be used on adjustable speed drives because the cooling air flow falls sharply with speed.

Alternating-current motors with class B insulation will provide a reserve of thermal capacity for heating due to frequent starts. Our experience indicates that class B insulation withstands the repeated shocks of starting very well.

Barking Drum

Most barking drum installations call for the motor to be mounted exposed to water and/or weather. Its size prohibits a T.E.F.C. motor so the selection is usually splashproof, although base ventilation may be an excellent choice.

Table I. Motor Application Tabulation

Driven unit	*Type*	*Insulation*	*Enclosure*	*Bearings*
		A. Wood Yard—Room		
1. Log conveyors	N.T.S.C.	Class A	T.E.F.C.	A.F.
2. Log conveyors to chipper	...	Special application	T.E.F.C.	A.F.
3. Bark conveyors	N.T.S.C.	Class A	T.E.F.C.	A.F.
4. Chip conveyors	N.T.S.C.	Class A	T.E.F.C.	A.F.
5. Chip screens	N.T.S.C.	Class A	T.E.F.C.	A.F.
6. Rechipper (shredder) for oversize chips	N.T.S.C.	Class A	T.E.F.C.	A.F.
7. Barking drums		Special application		
8. Chippers		Special application		
		B. Digesters		
1. Liquor pumps	N.T.S.C.	Class A	T.E.F.C.	A.F.
		C. Washing Plant		
1. Washer drives		Special application		
2. Liquor and water pumps	N.T.S.C.	Class A	T.E.F.C.	A.F.
3. Agitators	N.T.S.C.	Class A	T.E.F.C.	A.F.
4. Repulpers	N.T.S.C.	Class A	T.E.F.C.	A.F.
5. Foam breakers	N.T.S.C.	Class A	T.E.F.C.	A.F.
6. Screw conveyors	N.T.S.C.	Class A	T.E.F.C.	A.F.
7. Take-off rolls	N.T.S.C.	Class A	T.E.F.C.	A.F.
8. Stock pumps	N.T.S.C.	Class A	T.E.F.C.	A.F.
		D. Stock Preparation		
1. Water and stock pumps	N.T.S.C. or syn.	Class A	T.E.F.C.	A.F. or sleeve
2. Stock screens	N.T.S.C.	Class A	T.E.F.C. or D.P.	A.F.
3. Deckers and thickeners		Special application		
4. Jordans		Special application		
5. Agitators	N.T.S.C.	Class A	T.E.F.C.	A.F.
6. Knotters	N.T.S.C.	Class A	T.E.F.C.	A.F.
7. Hydrapulpers	N.T.S.C. or S.R.[a]	Class A	D.P. or S.P.	A.F. or sleeve
8. Beaters	N.T.S.C. or S.R.[a]	Class A	D.P.	A.F. or sleeve
9. Refiners		Special application		
		E. Paper Machine Room		
1. Fan pumps		Special application		
2. Stock pumps	N.T.S.C. or syn.	Class A	T.E.F.C.	A.F.
3. Water pumps	N.T.S.C. or syn.	Class A	T.E.F.C.	A.F.
4. Vacuum pumps	Syn. or N.T.S.C.	Class A	S.P. or D.P.	Sleeve or A.F.
5. Consistency regulators	N.T.S.C.	Class A	T.E.F.C.	A.F.
		F. Finishing Room		
1. Cutters	D.C.	Class A	D.P.-Prot.	A.F.
2. Trimmers	N.T.S.C.	Class A	D.P.-Prot.	A.F.
3. Broke bailers	H.S.T.S.C.	Class A	D.P.-Prot.	A.F.
		G. Recovery		
1. Liquor feed pumps	N.T.S.C. or S.R.	Class A	T.E.F.C.	A.F.
2. Agitators	N.T.S.C.	Class A	T.E.F.C.	A.F.
3. Boiler draft fans	N.T.S.C.	Class B	T.E.F.C.	A.F.
4. Disk evaporators	N.T.S.C.	Class A	T.E.F.C.	A.F.
5. Liquor pumps	N.T.S.C.	Class A	T.E.F.C.	A.F.
6. Chemical conveyors	N.T.S.C.	Class A	T.E.F.C.	A.F.
7. Lime kilns		Special application		
		H. Causticizing and Liquor Making		
1. Classifiers	N.T.S.C.	Class A	T.E.F.C.	A.F.
2. Agitators	N.T.S.C.	Class A	T.E.F.C.	A.F.
3. Liquor pumps	N.T.S.C.	Class A	T.E.F.C.	A.F.
		I. Boiler House and Power Plant		
1. Water pumps	N.T.S.C.	Class A	D.P.	A.F.
2. Water supply pumps	Syn.	Class A	D.P. or T.E.F.V.	Sleeve
3. Coal pulverizers	N.T.S.C.	Class A	D.P.	Sleeve or A.F.
4. Boiler draft fans	N.T.S.C.	Class A or class B	T.E.F.V.	Sleeve
	N.T.S.C.	Class A	T.E.S.C.	Sleeve
5. Boiler feed pumps	N.T.S.C.	Class A or class B	D.P. or S.P.	Sleeve
	Syn.	Class A or class B	D.P. or S.P.	Sleeve
6. Coal feeders	D.C.	Class A	D.P. or T.E.	A.F.
	N.T.S.C.	Class A	D.P. or T.E.	A.F.
7. Coal scales	N.T.S.C.	Class A	T.E.F.C.	A.F.
8. Air compressors	Syn.	Class A	Engine	Compressor
		J. Bleach Plant		
1. Washer drives		Special application		
2. Liquor and water pumps	N.T.S.C.	Class A	T.E.F.C.	A.F.
3. Stock pumps	N.T.S.C.	Class A	T.E.F.C.	A.F.
4. Agitators	N.T.S.C.	Class A	T.E.F.C.	A.F.
5. Mixers	N.T.S.C.	Class A	T.E.F.C.	A.F.
6. Caustic and brine pumps	N.T.S.C.	Class A	T.E.F.C.	A.F.
7. M-G power sets	N.T.S.C. or syn.	Class A	T.E.F.C.	Sleeve
		K. Wood Grinding		
1. Grinders	Syn.	Class B	D.P. or T.E.F.V. Sep. motor rm.	Sleeve
2. Stock pumps	N.T.S.C.	Class A	T.E.F.C.	A.F.

The starting torque of a loaded barking drum is high and frequent starts and stops are encountered. A wound rotor motor fits this application.

The bearings of this motor are subject to shock loading from the tumbling logs as the motor is connected to the drum through chain or belt drive, and this factor influences the design of the bearings. Either antifriction or sleeve bearings can be used.

Class A insulation is adequate.

Washers, Thickeners, and Deckers

It is desirable to have a variable speed drive that is easily controlled by wash plant operators. A convenient method of obtaining this speed variation is by a "Ward Leonard" system. There are on the market, a variety of "package" drives that provide this type speed control and are ideal for this application.

Direct-current motors with a two to one speed range by field control are also being used very successfully.

Other washers, deckers, and thickeners in the mill do not require the range of speeds that the washers in the wash plant demand. On these applications straight squirrel-cage (single or multiple speed), squirrel-cage with mechanical speed changers, or wound rotor induction motors are applicable.

Motors in this application are subjected to direct contact with water, fumes, and chemicals. T.E.F.C. motors are well justified in this application.

Insulation should be class A.

Jordans

Jordans usually rotate from 360 to 500 r.p.m. and depending on their size, require from 100 to 500 hp. A synchronous motor, coupled directly with some sort of telescopic coupling, is recommended for this application. If the jordan is started with the plug backed out, 50% starting, 50% pull-in, and 150% pull-out torque is adequate. If it is started with the plug in, 100% pull-in torque should be provided since appreciable pumping action is encountered.

Jordan motors are subjected to splashing pulp and to direct streams of water when the jordans are being "hosed down," and therefore require a maximum of protection. Totally enclosed externally ventilated motors are very attractive as the motors are grouped and one ventilating system can supply a number of jordans. There are, however, a large number of drip proof installations that have proved satisfactory. Many mills when using dripproof jordan motors install a shield between the jordan and the motor to deflect direct stream of water.

Class A insulation is usually specified with the motor being rated 40°C. temperature rise. In mills where jordans are subject to operating for long periods at overloads, as is true in much of the industry, class B insulation is becoming more common. Our experience with class B insulation has been very good, and the life of a jordan motor winding has been increased materially by its use.

[a] Under special circumstances, synchronous machines are satisfactory.

Notations: N.T.S.C.—normal torque squirrel cage; T.E.F.C.—totally enclosed fan cooled; T.E.S.C.—totally enclosed surface cooled; T.E.F.V.—totally enclosed forced ventilated; D.C.—direct current; A.F.—antifriction; D.P.—dripproof; D.P.-Prot.—dripproof-protected (screened) (D.C. and S.R. only); S.P.—splashproof; S.R.—slip ring (wound rotor); Syn.—synchronous; and H.S.T.S.C.—high starting torque squirrel cage.

Jordan motors generally use sleeve bearings to allow end play. The jordan itself is provided with a thrust bearing although some jordan motors have collar or ball bearing thrust bearings to take care of the thrust necessary to slide the telescopic coupling.

Beaters

Beater speeds vary from approximately 80 to 175 r.p.m. and horsepower ratings go as high as 350. Beaters frequently have to be started loaded and this results in high-starting torques. Wound rotor motors are most suitable in this application. These motors are belted to the beaters. Directly connected synchronous motors may also be applied but should have a high-starting torque. Starting torque 125%, 100% pull in, and 175% pull out should be satisfactory.

The wet conditions around a beater, point to a splashproof construction or a totally enclosed externally ventilated motor. Class A insulation is recommended and either ball bearings or sleeve bearings.

Fan Pump

A fan pump is subject to a variety of selections, depending on the method of governing the flow of stock to the headbox and the speed of the pump itself.

Slow speed pumps will indicate synchronous motors, while higher speed pumps will indicate induction motors. The constant speed characteristic of synchronous motors can be valuable in maintaining a constant flow of stock. If the stock delivered by the pump is to be regulated by speed, a wound rotor motor is often used. Variable speed d.c. drives are also being applied.

Class A insulation is adequate and either sleeve or antifriction bearings are applicable.

Lime Kilns

The starting torque of a kiln is high and a wound rotor motor not only provides this high-starting torque but provides a means of varying the speed of the kiln.

Two (or four speed)-constant torque-induction motors are also applicable.

Kiln motors must be protected from contact with the lime and also from the weather. T.E.F.C. or totally enclosed externally ventilated motors should be used.

Maximum reliability is essential in a kiln drive as a hot kiln will warp if it is stopped.

GENERAL MOTOR APPLICATION

Table I lists a group of common motor applications in the mill and the suggested motor type, insulation, enclosure, and bearings.

It is difficult to make a definite recommendation for all of these motors as the existing conditions for a given application will vary greatly in different mills. The size of the motor, as well as the surrounding conditions will influence the selection of all items listed.

As motors approach 50-hp. ratings there is always a choice between sleeve bearings and antifriction bearings.

This table will serve as an outline of our experience and preference in selecting motors.

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Methods for Measuring the Retention of Polysaccharide Beater Additives

ELLSWORTH H. SHRIVER, II, M. B. WEBB, and JOHN W. SWANSON

Two new analytical techniques are described for the fundamental study of the retention of polysaccharide beater additives by pulps. One of these methods makes use of the anthrone test for carbohydrates (which is more sensitive than iodine is for starch) combined with a Celite filtration method. The other technique employs a relationship between viscosity and concentration for many high polymers where the molecular distribution may be assumed constant. It is shown that these methods correlate very well but that slightly higher concentrations are obtained on samples measured by the anthrone technique as compared with the viscometric technique. These small differences, however, result in calculated sorptions for the viscosity technique which are about 1½ to 2 times those obtained with anthrone. This is probably due to lack of quantitative filtration of cellulose fines in the presence of the methylcellulose which is a known deflocculating agent. The analytical variability was ascribed to the nonuniformity of pulp samples.

PAPER IS modified in a variety of ways to meet consumer demands. One of these modifications is the incorporation of additives into the pulp furnish.

The use of additives in papermaking is attracting increasing interest in the industry not only for certain specialty papers, such as those with wet strength, but also for the purpose of decreasing power requirements in the hydrating of pulps, permitting an increased use of shorter-fibered or poorer quality pulps in furnishes, and increasing the strength properties of existing pulps.

Additives are introduced in the wet-end system of the paper machine in amounts approximating several per cent of the fiber present. Since wet-end pulp consistencies are usually below 5%, the absolute concentration of additive is very low. In order to be effective, the additive must be picked up by the fiber from this dilute solution. Fundamental studies on additive retention have not been extensive and this is particularly true of water-soluble polysaccharides. Additional information on the manner of additive sorption and the factors which influence this sorption should result in more effective utilization of these new papermaking raw materials.

In this paper are reported studies on two new techniques for measuring the retention of water-soluble cellulose ethers and of locust bean gum (a polymannogalactan) by papermaking pulps. In a subsequent paper experimental results using these methods with several water-soluble cellulose ethers will be given.

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RAW MATERIALS

Table I is a brief tabulation of the additive raw materials utilized and their characteristics.

Table I. Properties of Additive Raw Materials

Grade, cp.	*Alkoxyl, %*	*Ash ($NaCl + Na_2CO_3$)*	*Arrhenius viscosity constant*	*Viscosity molecular weight*
		Methylcellulose (Dow Methocel)		
25	32.6	0.09	0.84	31,000
100	30.7	0.15	1.38	53,000
400	31.5	0.07	2.12	84,000
4000	30.8	0.03	3.34	126,000
		Ethylcellulose		
74	33.7	0.09	0.55	24,000

Mannan, %	*Galactan, %*	*Acid insolubles, %*	*Ash, %*	*Arrhenius viscosity constant*	*Intrinsic viscosity[a]*
		Locust Bean Gum			
75.4	20.0	0.58	0.22	5.31	12.0

[a] Defined by Kramer as $(\eta_{sp.}/c)\ c \rightarrow 0$, where $\eta_{sp.}$ = specific viscosity and c = concentration (grams/100 ml.).

The water-soluble cellulose ethers were obtained in five different grades and were white, fibrous products made by the Dow Chemical Co. of Midland, Mich., which kindly furnished some of the analytical data. The grade of methylcellulose or ethylcellulose refers to the viscosity in centipoises of a 2% solution at 20°C. Solutions of methylcellulose are made by soaking the material for 0.5 hour in half the required water for dilution at near the boiling temperature. After this soak, water is added to nearly the mark on the volumetric flask. The suspension is cooled below 10°C. until the methylcellulose is completely in solution; the solution is diluted to the mark after bringing the flask and contents to room temperature. Solutions of required concentration are made by volumetric dilution from 0.5% stock solutions. Stock solutions may be stored at room temperature.

The ethylcellulose was an experimental sample and solutions were made in a manner similar to that used for the methylcellulose except that stock solutions were filtered before using, since the ethylcellulose was only 68.5% water soluble.

The locust bean gum was a white powder obtained from Italy through Innes Speiden Co., New York, N. Y. The gum was purified by dispersing the dry powder in a 1% water solution and heating rapidly to 90°C. for 20 minutes. After supercentrifuging and cooling, the solute was precipitated in three times the solution volume of alcohol (95%). The precipitate was filtered on cloth and redispersed in absolute alcohol in a Waring Blendor. After filtering, the precipitate was allowed to stand overnight in absolute ether, filtered, and dried

at 50% R.H. Gum solutions were made by gravimetric dilution from a 0.5% stock solution obtained by heating the purified powder in water at 90°C. and diluting to the proper weight in a flask after cooling to room temperature. The gum stock solutions were kept in the refrigerator to avoid bacterial degradation.

The Arrhenius viscosity constant in Table I is part of the equation $\log \eta_r = kc$ where η_r = relative viscosity and c = concentration in grams per 100 ml. The viscosity molecular weights were based on the Staudinger equation

$$[\eta] = KM$$

where

$[\eta]$ = intrinsic viscosity
M = molecular weight
K = Staudinger constant: 6.0×10^{-5} for methylcellulose when concentration is expressed in grams per 100 ml. or 11×10^{-4} when expressed in gram monomer weights per liter

ANALYTICAL METHODS

The sorption* or retention of a sorbate by a sorbent may be determined by one of two basic methods. The first is to measure the sorbed substance directly on the sorbent or to strip the sorbate from the sorbent before analysis. This allows use of the so-called "infinite bath," in which the bulk concentration of the sorbate is maintained essentially constant during sorption. The other method is to measure the change in concentration of the sorbate in the solvent. The change in concentration multiplied by the volume of the solvent then gives the quantity picked up by the sorbent. Analytically speaking, the first method is the better since it measures directly the quantity desired. In addition, it permits sorption determinations at a constant concentration of sorbate. However, the problem of the removal of mechanically held liquor from the sorbent is a difficult one. The sorbate in the imbibed liquor will be analyzed as sorbed material when actually it is not. The sorbent cannot be washed with solvent if the sorption is reversible, since sorbate will be removed. The second method measures a difference and consequently must be very sensitive. It also tends to be inaccurate if this difference is small—i.e., very little sorption.

USE OF ANTHRONE

A colorimetric test which appears to meet the specification of sensitivity for measuring sorption on cellulose by concentration difference is that involving the use of anthrone. Anthrone is a reduction product of anthraquinone and is formed by heating the latter under reflux in the presence of granulated tin and a mixture of acetic and hydrochloric acids (*1*, *2*).

Anthrone was initially used as test for glycerol (a red color is formed) in paper (*2*). The compound may now be obtained commercially in reasonably pure form (*7*).

Anthraquinone — Anthrone

In 1946, Dreywood proposed anthrone as a sensitive test for carbohydrates (*3*). A positive blue-green color was given by a group of 18 carbohydrates, including starch and cellulose, a hexose, a pentose, some natural gums, cellulose ethers, and cellulose esters. Furfural was the only noncarbohydrate giving the test. In essence, the anthrone test comprises the mixing of 1 volume of carbohydrate solution with 2 volumes of anthrone reagent (prepared by dissolving anthrone in concentrated sulphuric acid to give a 0.2% solution).

In 1948, Morris (*4*) confirmed the claims of Dreywood and used the reagent for the quantitative colorimetric determination of glucose, maltose, fructose, α-methyl glucoside, galactose, and lactose with a filter photometer. Beer's law was obeyed at 620 mmu. Morse (*5*) used anthrone for the measurement of sucrose (concentrations of 10 to 25 p.p.m.) in beet sugar waste liquors. Sattler and Zerban (*6*) continued the work on the specificity of the test and hypothesized that the anthrone color was due to the formation of furfural-type compounds in the strong sulphuric acid. Viles and Silverman (*7*) applied anthrone to the analysis of starch and cellulose in cotton lint from air samples in textile mills.

Morris (*4*) swirled the anthrone reagent and carbohydrate solution in the test tube to effect mixing, whereas Morse (*5*) shook the test tube (like a clinical thermometer) or used a glass stirrer after forming two layers of reagent and solution. Viles and Silverman (*7*) preferred a rapid mixing as reagent was added. It was found in the present investigation that neither a glass stirrer nor vertical shaking yields precise results. A pouring technique, however, was found to give a precision on duplicate determinations of ±0.5% transmittance from the mean. This technique consists of cautiously adding the reagent to the solution in order to form a double layer. The two layers are then poured rapidly into a clean test tube and poured back into the original one. Shaking the test tube with an oscillatory motion of the forearm for 15 seconds also gave results identical with those of the pouring technique. Both methods were used successfully in the present investigation.

Spectral transmittance curves were run on the General Electric Recording Spectrophotometer for the hexoses, oligohexoses, polyanhydrohexoses, pentoses, and derivatives listed in Table II. Typical curves are presented in Figs. 1 to 4. The information given by these curves provides almost quantitative proof of the theory of Sattler and Zerban that hydroxymethylfurfural formed from hexoses in acid solution is responsible for the anthrone color. Except for minor deviations, the spectral curve of hydroxymethylfurfural is identical with the curves obtained for a variety of hexoses (see Figs. 1 and 2). The optimum wavelength for the spectrophotometric analysis for all the hexoses studied was found to be 625 mmu, in agreement with the findings of Viles and Silverman for cellulose and starch.

The present work confirmed the formation of blue-green color for the hexoses and pentoses studied, but it was found that the pentose color was not stable and changed very rapidly into a brownish-red or amber

* This general term, first introduced by J. W. McBain, is used to avoid premature commitment as to the mechanism of retention—whether adsorption, absorption, or a combination of the two.

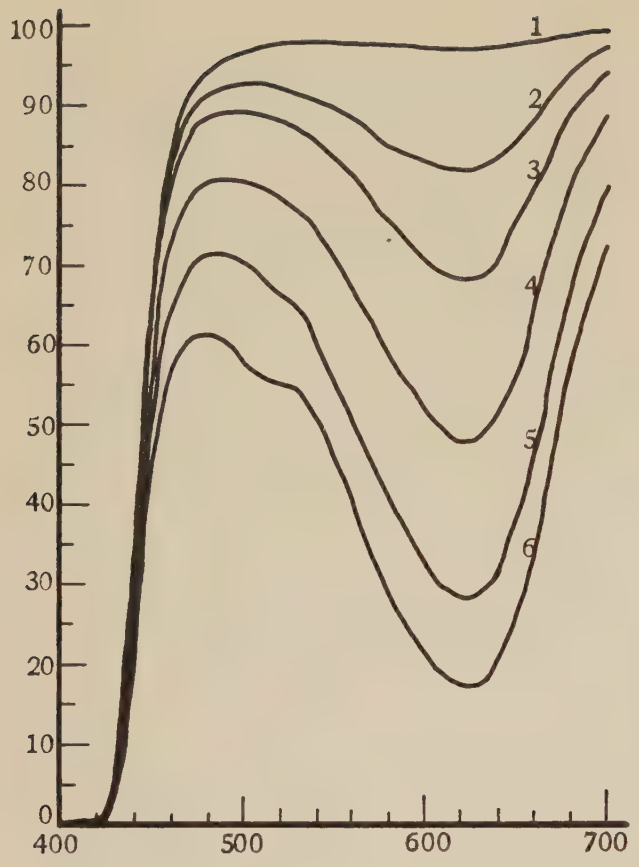

Fig. 1. Glucose

1-day reagent. Reference liquid: 2:1 concentrated sulphuric acid-water. (1) Blank, (2) 0.0005, (3) 0.001, (4) 0.002, (5) 0.0035, (6) 0.005 g./100 ml.

color. The spectral transmittance curve for the amber pentose color is quite different from that for the blue-green hexose color. Furfural also showed the initial formation of a blue-green color, followed by the rapid shift to amber. The spectral curve of the amber furfural color was very similar to those for arabinose and xylose (see Figs. 3 and 4). This is further evidence in support of the hypothesis that furfural-type compounds are precursors of the anthrone color. The blue-green to amber color shift of the pentoses immediately suggests anthrone as a qualitative test for differentiating hexoses and pentoses.

The methylpentoses (fucose and rhamnose) give the stable blue-green hexose color, but furoic acid and furfuryl alcohol give the transient blue-green color, followed by the stable amber pentose color. It was previously noted that glycerol gives a red color with anthrone. This is apparently due to the formation of acrolein from glycerol in the strong hot acid present, since acrolein alone gives a red color.

Formaldehyde and propionaldehyde also give a red color. Mixing of the red aldehyde color with the blue-green hexose color produces a color similar to the amber pentose color. An arabogalactan isolated from western larch gave the blue-green hexose color which changed to reddish-green on standing, indicating a mixture of blue-green hexose and amber pentose color. These qualitative observations are presented as a matter of interest, since it would be unwise to postulate a reaction mechanism between furfural-type com-

Table II. Anthrone Extinction Coefficients of Carbohydrates

Carbohydrate	Specific extinction coefficient, 100 ml. g. × cm.⁻¹ 625 mmu	Gram equivalent weight	Equivalent extinction coefficient, 100 ml. equivalents × cm.
Glucose	151	180	27,200
Cellobiose	158	171	27,000
Maltose hydrate	153	180	27,500
Fructose	146	180	26,300
Sucrose	157	171	26,900
Tetramethyl glucose	114	236	26,900
Methylcellulose (31.5% MeO)	131	189	24,800
Ethylcellulose (33.7% EtO)	101	205	20,700
Galactose	81.4	180	14,650
Mannose	70.4	180	12,680
Locust bean gum	72.4	162	11,730
Lactose hydrate	120	180	21,600
Hydroxymethylfurfural	2748	126	347,000
	580 mmu		
Arabinose	8.2– 15.4	...	...
Xylose	15.6– 33.3	...	...
Furfural	55.0–103.2	...	...

Note: Tests made with 10 ml. 0.2% anthrone in concentrated sulphuric acid (Du Pont) added to 5 ml. carbohydrate solution in 25-mm. test tubes. Mixed by pouring once to a clean test tube and pouring back. Reagent 1 to 3 days old for hexoses and derivatives (except 9 days for ethylcellulose); 5 days for pentoses and derivatives. The absorption equation used was $T = 10^{-bcx}$, where T = transmittance, b = specific extinction coefficient, c = concentration in g./100 ml., and x = cell depth (in this case 1 cm.).

pounds and anthrone in the strong hot sulphuric acid (78.5% at about 90°C.) of the reaction zone.

As mentioned previously, the optimum wavelength (maximum absorption) was 625 mmu for the hexoses where Beer's law was obeyed in an excellent manner. Beer's law was not obeyed at 500 mmu (the maximum of the transmittance curve) as would be expected but was obeyed at 530 mmu, which is slightly to the right

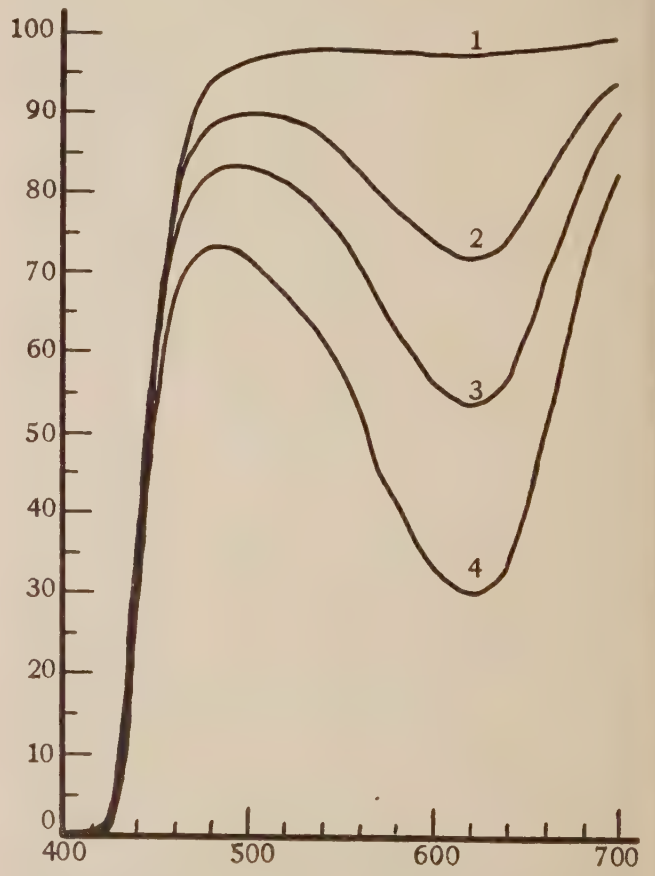

Fig. 2. Hydroxymethylfurfural

1-day reagent. (1) Blank, (2) 0.000432, (3) 0.000864, (4) 0.001728 g./100 ml.

of this maximum. Unfortunately, Beer's law was not obeyed for any wavelength for the amber pentose color, which decreases the usefulness of the test for these sugars. In addition, the blue-green color formed by pentoses appears too transient to permit transmittance readings. Perhaps a careful calibration of the reagent with a pentose would permit quantitative measurements.

Included in Table II are the specific extinction coefficients, equivalent weights, and equivalent extinction coefficients at a wavelength of 625 mmu for the carbohydrates studied. It will be noted that the equivalent extinction coefficients for all hexoses yielding glucose and/or fructose on hydrolysis are approximately equal, with the exception of methyl- and ethylcellulose. Apparently there is some steric effect which decreases the rate of conversion of the methyl- and ethylcelluloses to furfural-type compounds resulting in a weaker color. The influence of ether groups as such is negligible as can be seen from the data for tetramethylglucose. The evidence for steric hindrance is supported by the highly hydrated nature of the water-soluble cellulose ethers plus the fact that the color for ethylcellulose is weaker than that for methylcellulose, indicating a greater steric effect with ethoxyl groups. The possibility that β-glucoside linkages are sufficiently more resistant to hydrolysis than α-linkages to decrease the rate of conversion to furfural compounds might be considered, but this is ruled out as the sole explanation because the coefficients of methyl- and ethylcellulose are not equal.

Galactose and mannose have much lower extinction coefficients (i.e., a weaker blue-green color for a given concentration) than glucose- or fructose-containing

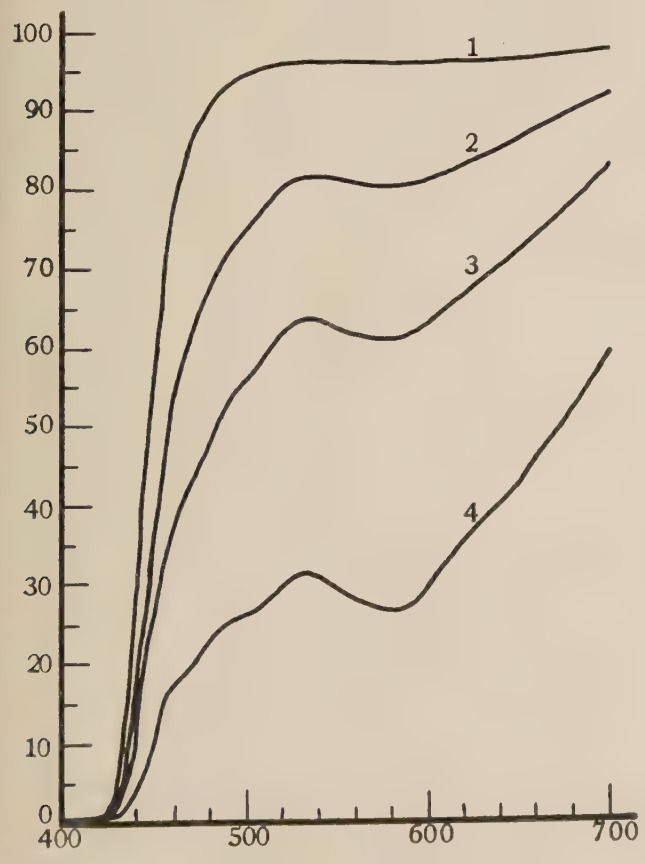

Fig. 3. Xylose

5-day reagent. (1) Blank, (2) 0.005, (3) 0.01, (4) 0.02 g./100 ml.

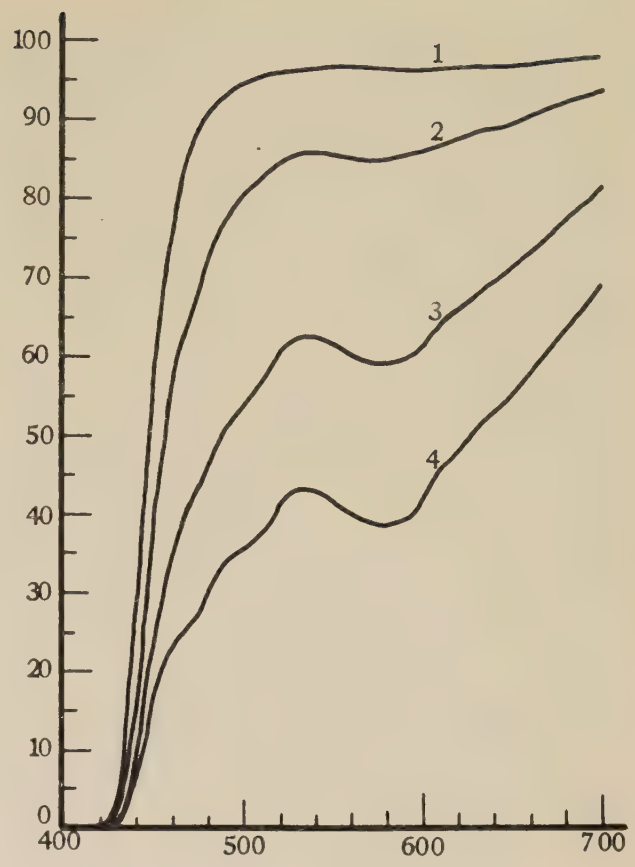

Fig. 4. Furfural

5-day reagent. (1) Blank, (2) 0.001, (3) 0.0025, (4) 0.004 g./100 ml.

sugars. Locust bean gum is a polymannogalactan containing a ratio of approximately 75:20 anhydromannose to anhydrogalactose. The extinction coefficient for the gum is seen to fall a proportional distance between those for mannose and galactose. In like manner lactose hydrate consists of equal amounts of glucose and galactose residues. The lactose extinction coefficient lies very nearly halfway between those of its components. The foregoing data are in excellent agreement with those of Morris (*4*).

Calibration curves for methylcellulose and locust bean gum are given in Fig. 5. Considering a 0.5% transmittance change as the limit of sensitivity in colorimetric analysis, anthrone will measure methylcellulose and locust bean gum concentration changes of 0.0001 gram per 100 ml. and 0.0002 gram per 100 ml., respectively, in the optimum transmittance range.

SEPARATION OF CELLULOSE FROM ADDITIVE

Since any hexose or polyhexosan will give a blue-green color with anthrone, it is necessary to separate such a carbohydrate additive from cellulose in making retention measurements on pulps. Cellulose in water breaks down upon beating or handling into small fragments and debris which presumably have a distribution from supercolloidal to colloidal size, although evidence has been presented which indicates that fibrils of beaten papermaking fibers attain a minimum diameter of 200 to 300 A. (*8*).

It is this cellulosic debris which has given rise to the idea that cellulose may be "soluble" in water. Strachan (*9*) obtained a solubility value of 21 p.p.m. for cellulose

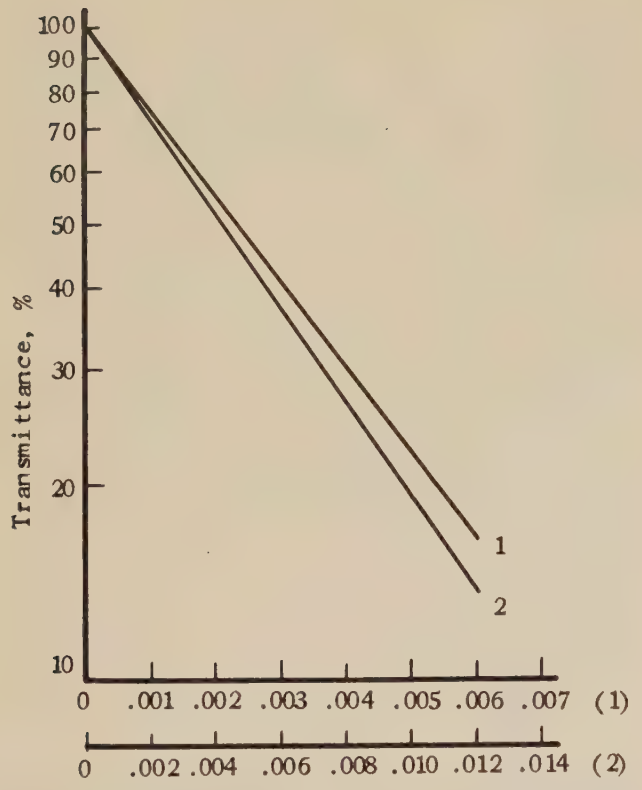

Fig. 5. Calibration curves for methylcellulose and locust bean gum

(1) Methylcellulose, g./100 ml.
(2) Locust bean gum, g./100 ml.

in water by extracting bleached spruce sulphite pulp at 15 to 18°C. (20 grams of pulp in 800 ml. water) after thorough removal of water-soluble impurities from the pulp. Unfortunately, no details are given of the filtration technique used for separating cellulose and water. The evaporated filtrate showed reducing power but Strachan admitted this may have resulted from hydrolysis during evaporation of the aqueous solution.

It has been found during the present investigation, however, that the concentration of cellulose in a water extract of well-beaten cotton linters may be reduced to as little as 0.5 p.p.m. of cellulose (equivalent to glucose as analyzed with anthrone) in water using only a Corning medium fritted glass filter and discarding the first portion of the filtrate. Various techniques using filtration through fritted glass and Celite pads and centrifugation indicated that "soluble" cellulose in the filtrate or centrifugate is largely a function of the method of separating liquid and solid phases. Centrifuging alone, for example, was found to give a solubility of 1 p.p.m. of unbeaten cotton linters in water. (The above extractions were all performed at 1% pulp consistency.)

In addition to these experiments, viscosity determinations on the supernatant liquid from a variety of settled pulp-water suspensions (0.5% consistency) show practically no viscosity increase over that of water. These pulps were previously extracted with hot water to remove water-soluble impurities. In another experiment on beaten cotton linters, an obviously turbid suspension showed no viscosity increase over water alone. Since lyophobic colloidal systems show only slight viscosity increase with increasing concentration, in contrast to lyophilic systems which exhibit a great viscosity increase, it must be concluded that cellulose is not appreciably soluble in a molecular sense but displays some of the properties of a lyophobic colloid in suspension.

METHODS OF SEPARATION INVESTIGATED

Since the work on methylcellulose and locust bean gum was proceeding concurrently in the early stages, somewhat different methods of attack were frequently used in attempting to separate cellulose fines from additive. Accordingly, these experiments will be reported separately.

Centrifugation and filtration appeared to be the simplest and most feasible methods of separating cellulosic debris from polysaccharide solutions. In the methylcellulose phase of the program, it was found that a centrifuge having a centripetal acceleration varying from 1.07 to 2.25 $\times$ 10^6 cm. per sec.^{2} over a path of 6 cm. (centrifuge of 14 to 20 cm. radius, 3200 r.p.m.) failed to quantitatively separate cellulose from water or from mixtures of polysaccharide solution with settled supernatant cellulose fines. Extracting the pulp with boiling water gave better results than extracting at room temperatures, but this may have resulted from a dehydration as a result of the boiling and a consequent better removal in the centrifugation. Although the use of centrifugation with boiled pulps showed great promise and will be investigated later, the major part of the present work was performed on pulps extracted with distilled water at room temperature. For these pulps, centrifugation as described was not adequate.

FRITTED GLASS FILTRATION

Two considerations are evident in the development of a filtration technique. First, the cellulose fines must be separated from the gum solution; second, the gum molecules must not be removed by ultrafiltration. A brief review of some of the experimental work in this connection will suffice to bring out the salient findings.

Methylcellulose

Ten millimeter fritted glass filters made by Corning were used. The "medium" porosity filters were tube-type microfilter funnels with the tube chipped down flush with the fritted disk, leaving the stem and the disk. Suction was applied to the stem. The "fine" porosity filters consisted of Corning straight tube sealing stock with a fritted disk in the middle. One end of the tube was cut flush with the fritted disk and discarded, leaving the other tube terminating in the disk. Suction was applied to the open end. In all experiments, 0.5% consistency pulp (1 gram in 200 ml. liquid) was used. For the additive experiments, 1 gram of pulp was added to 200 ml. of methylcellulose containing 0.005 gram per 100 ml. The general procedure was to allow the pulps to settle at least overnight and filter from the supernatant liquor.

It was found that medium fritted filters will quantitatively remove cellulosic debris from settled pulp-methylcellulose liquors without ultrafiltration of the additive by first "plugging" the filter with 20 to 25 ml. of liquor. Fine filters, on the other hand, appear to remove small amounts of additive from solution, as well as pulp fines, after being "plugged" with 5 to 10 ml.

of liquor. One of the greatest objections to both types of filters is the excessive filtration times required.

Locust Bean Gum

In the filtration work with locust bean gum, Corning medium fritted glass crucibles (30-mm. disk) modified by cutting the skirt flush with the fritted disk were used. The crucibles were used as filter sticks by applying suction to the open end.

It was found that successive increments of filtrate from the above crucibles decreased in concentration and appeared to come to a constant value after discarding about 20 ml. of filtrate.

FILTRATION WITH FILTER AIDS

Methylcellulose

In order to speed up the filtration technique, filter aids, such as analytical grade Celite (Johns-Manville diatomaceous earth) and acid-washed asbestos, were considered. Exploratory experiments indicated that both Celite and asbestos sorbed methylcellulose. This sorption amounted to approximately 0.3% (on the weight of the sorbent) for Celite and 0.1% for asbestos and did not vary appreciably with the molecular weight of the methylcellulose.

Filter pads 2 to 5 mm. in thickness were formed from slurries on Corning coarse tube-type microfilters. Standard methylcellulose solutions, as well as equal volume mixtures of standard solution and pulp-water supernatant cellulose fines, were recovered quantitatively from the filtrate of the above microfilters. These experiments indicated that methylcellulose was not undergoing ultrafiltration and that the filter aids were entirely removing the suspended cellulose. Because of the sorption of the methylcellulose by the filter aids, it was necessary to discard 20 ml. of filtrate before the standard solutions could be recovered without alteration of the concentration. Accordingly, the practice was adopted of making the Celite slurries for filter pads in a methylcellulose solution (0.010 gram per 100 ml.) instead of distilled water. This treatment assured saturation of the Celite and permitted recovery of standard solutions after washing the filter pad with a maximum of 10 ml. of the solution.

Locust Bean Gum

In an attempt to improve the uniformity of the Corning medium fritted glass filtering crucibles (30-mm. disk) used in the locust bean gum experiments, the crucibles were partially "plugged" (porosity decreased) by filtering 25 ml. of a settled Celite suspension (10 grams of Celite in 1 l. of water).

Filtration of gum-pulp suspensions with these plugged filters indicated a good precision between crucibles and a constant concentration after discarding 15 to 20 ml. of filtrate. Filtration of a standard gum solution in a crucible through which 20 ml. of an equilibrium gum-pulp liquor had been filtered indicated a measurable, but nevertheless slight, ultrafiltration of the gum solution. This ultrafiltration can probably be neglected for most purposes.

Celite Method for Methylcellulose

The following technique was finally adopted for anthrone measurement of methylcellulose retention.

1. The reagent consists of 2 grams of anthrone dissolved in 1830 grams of Du Pont concentrated sulphuric acid. The acid is shaken vigorously to insure dissolution of the anthrone. The reagent is stored at room temperature and is aged 1 day before use.

2. Samples from pulp (1 gram oven-dry) stored at 16 to 30% consistency are dispersed to give 0.5% consistency in a given methylcellulose solution and are rotated at constant temperature for sufficient time to insure equilibrium and then allowed to settle at least overnight. Twenty-five milliliters of supernatant liquor is removed with a pipet and centrifuged 15 minutes in a field of approximately 1.5×10^6 cm. per sec.^{2} centripetal acceleration with 0.1 gram glass wool.

3. Five milliliters of the centrifugate is diluted volumetrically so that the diluted concentration of methylcellulose lies between 0.001 and 0.005 gram per 100 ml.

4. Saturated filter pads are prepared by stirring 0.5 gram of Celite in 50 ml. of methylcellulose (0.010 gram per 100 ml.). Approximately 6 ml. of this slurry will form a 3 to 4 mm. filter pad on a Corning coarse tube-type microfilter.

5. Ten to twelve milliliters of the diluted sample are sucked through the saturated filter pad, after which 6 to 9 ml. of the filtrate is obtained in a clean 15-mm. sidearm test tube.

6. This filtrate is centrifuged in a clinical centrifuge for 1 minute to remove Celite which has been dislodged from the bottom of the filter pad. For routine analysis this last centrifugation is not required since the amount of Celite present is small.

7. Five milliliters of the centrifuged filtrate is placed in a 25 by 150 mm. test tube and 10 ml. of anthrone reagent is added cautiously to form a double layer. The contents of the test tube are poured rapidly into a clean test tube and then returned to the original tube.

8. The test tube is stoppered and the mixture is allowed to air cool in a test tube rack for 10 minutes after which the transmittance of the solution is read in a 1-cm. absorption cell at a wavelength of 625 mmu on a model 14 Coleman Universal Spectrophotometer, using reagent and water as a reference liquid. Air entrapped in mixing occasionally deposits on the face of the absorption cells. This can be removed by evacuation in a desiccator for several minutes.

9. For calibration, two samples of methylcellulose (0.005 gram per 100 ml.) are run and a straight line drawn through the average of these points on a log transmittance vs. concentration plot. Calibration is preferably done at the time samples are run or at least within one day of the running of samples. The concentrations of the samples are obtained from this curve. The concentration of supernatant liquor is obtained by multiplying the analytical concentration by the appropriate dilution factor.

10. The sorption of additive is equal to the total initial additive less the equilibrium concentration times the liquid volume of the system.

Celite Method for Locust Bean Gum

The following is the technique finally adopted for anthrone measurement of locust bean gum retention.

1. The reagent consists of 2 grams of anthrone dissolved in 1 l. of 93% sulphuric acid. The solution is

stirred thoroughly. Dissolving the anthrone at 40°C. seems to be preferable.

2. Samples from pulp stored at 16 to 30% consistency are dispersed to give 0.5% consistency in a given locust bean gum solution and are stirred at room temperature for sufficient time to insure equilibrium. Samples are obtained through Celite-treated modified fritted glass crucibles and diluted so that the final concentration lies between 0.002 and 0.010 gram per 100 ml. Samples are obtained from similar pulp-water suspensions.

3. Five milliliters of the diluted sample are placed in a 25 by 200-mm. test tube and stoppered. Ten milliliters of anthrone are added from a 25-ml. buret to form a double layer. The test tube is shaken with an oscillatory motion for 15 seconds. The sample is then air cooled 10 minutes and the transmittance read in a 1-cm. cell with a filter photometer using a Wratten No. 23 and BG-18 filter, employing reagent and water as a reference liquid.

4. For calibration, samples of 0.002, 0.005, 0.008, and 0.010 gram per 100 ml. are run and plotted on a concentration versus log transmittance plot. The concentrations of samples are obtained from this curve.

5. Sorption of additive is computed by subtracting the sample concentration times the liquid volume of the system (less the apparent carbohydrate in the similar pulp-water suspension) from the initial amount of gum.

VISCOMETRIC METHOD

In a solution of a given high polymer in a given good solvent, the viscosity exhibited is a function of the molecular weight distribution of the polymer and its concentration. The above statement is true provided the concentration is such that viscometric anomalies (i.e., failure to obey Poiseuille's law) do not occur. For a given molecular weight distribution, viscosity is a function of concentration. Viscosity, therefore, is a possible means of measuring the concentration of polysaccharide additives after sorption on cellulose. The requirements for such a method are that materials leached from the cellulose contribute nothing to the viscosity (or can be corrected for) and that sorption does not alter the molecular weight distribution of the sorbate. Another way of stating this latter requirement is to say that the molecular weight distribution in the sorbed phase must be the same as that of the liquid phase. These requirements appear to be largely met in working with papermaking pulps.

Of the many empirical equations which have been proposed quantitatively relating viscosity and concentration (*10*), the earliest and simplest is that of Arrhenius (*11*):

$$\log \eta_r = kc$$

where

η_r = relative viscosity—i.e., the ratio of solution to solvent viscosity
c = concentration of solute in appropriate units
k = a constant

In a capillary viscometer, such as that used in the present study, the relative viscosity is

$$\eta_r = (td)/(t_0 d_0)$$

where t and t_0 are, respectively, solution and solvent efflux times and d and d_0 are densities. For the usual case with dilute solutions, where $d \cong d_0$, the relative viscosity is simply the ratio of the solution and solvent efflux times.

The Arrhenius equation was obeyed in an excellent manner by all the raw materials studies up to 0.1 gram per 100 ml. (the highest concentration used).

Viscosity data on the various grades of methylcellulose used are presented in Table I. The viscometric analytical technique is as follows:

1. Samples from pulp (1 gram oven-dry) stored at 16 to 30% consistency are dispersed to give 0.5% consistency in a given additive solution and are rotated at constant temperatures for a sufficient time to insure equilibrium and then allowed to settle at least overnight. Twenty-five milliliters of supernatant liquor are decanted by pipet and centrifuged 15 minutes in a field of approximately 1.5×10^6 cm. per sec.^{2} centripetal acceleration with 0.1 gram glass wool.

2. After bringing to 25°C., 10 ml. of the centrifugate is introduced into a Cannon-Fenske (*12*) (Ostwald type) Series 50 viscometer through a Corning coarse microfilter funnel. Liquid held in the microfilter stem can be forced out with gentle air pressure. The viscometer is held in a bath at 25 ± 0.01°C. After allowing 5 minutes for temperature equilibration, the solution efflux time is measured in duplicate with a stopwatch to the nearest 0.1 second.

3. The relative viscosity of this solution is computed from the efflux times of solution and solvent, respectively, and the concentration of the solution is obtained by substitution into the Arrhenius viscosity equation using the appropriate constant. Sorption is calculated by subtracting the equilibrium concentration times the liquid volume of the system from the initial methylcellulose present.

The viscometric analytical sensitivity is, of course, dependent on the molecular weight of the particular methylcellulose or locust bean gum sample under consideration. Assuming 0.5 second as the limit of sensitivity in making viscosity runs, then a concentration change of 0.0009, 0.0003, 0.0002, and 0.0001 gram per 100 ml. could be detected for 25, 400, and 4000 cp. methylcellulose and locust bean gum, respectively. This sensitivity is relatively constant up to 0.1 gram per 100 ml. concentration.

In studying the viscometric analytical method, it was discovered that the water extract of cotton linter pulps had practically the same viscosity as water and so it was hoped that this would be the case for all pulps. However, it was soon learned that sulphite and kraft pulps had an appreciable "residual" viscosity, which remained after extracting with water at room temperature. This residual viscosity was apparently not due to inorganic impurities, since each of the pulps was extracted with cold water until the extract pH lay between 6.5 to 7.0. The residual viscosity could be greatly reduced by batch extracting pulp samples for two 1-hour periods at 60 to 80°C. and practically eliminated with three 1-hour extractions with boiling water.

Table III contains viscosity data on the various pulps studied. The "residual" viscosity was determined by rotating pulp samples at 0.5% consistency in distilled water for 3 to 5 days at room temperature and analyzing the settled liquor or its centrifugate according to the viscometric analytical scheme. In addi-

Table III. Residual Viscosity of Pulps

Pulp		Before extraction Boiling water: Relative viscosity supernatant liquor	Before extraction Boiling water: Relative viscosity centrifugate	After extraction Boiling water: Relative viscosity liquor	After extraction Boiling water: Relative viscosity centrifugate
Cotton linters	795 S.-R.	1.008	1.006	...	...
	470 S.-R.	1.002	...	...	...
	335 S.-R.	1.002	1.001	...	...
Western hemlock	Bleached sulphite unbeaten	1.042	...	...	...
	770 S.-R.	1.029	...	...	...
	570 S.-R.	1.031	...	1.002	1.001
	300 S.-R.	1.044	...	...	...
Jack pine	Bleached kraft unbeaten	...	1.018	...	...
	775 S.-R.	1.027	1.027	...	...
		...	1.036	...	...
		...	1.033	..	...
	580 S.-R.	...	1.024	...	...
	325 S.-R.	...	1.034	...	...
Jack pine	Bleached kraft[a] unbeaten	1.012	...	...	...
	580 S.-R.	1.015	1.015	1.003	1.003
	325 S.-R.	1.005	...	...	...
Western hemlock	Unbleached sulphite[b] unbeaten	1.001	...	...	...
	630 S.-R.	1.006	1.003	1.002	1.000
Jack pine	Unbleached kraft[b] unbeaten	1.005	...	...	...
	610 S.-R.	1.004	1.001	1.001	1.001

[a] Re-extracted with cold water.
[b] Pulp extracted for two 1-hour periods at 60 to 80°C. instead of with cold water only.

tion to the effect of extraction in boiling water, the information in Table III indicates that centrifuging has only a minor effect on the residual viscosity and can be practically ignored for the boiling water extracted pulps. This means that analytical samples could be taken directly from the supernatant liquor.

The pulp residual viscosity was obviously due to water-soluble polysaccharides which leach out of the pulp, but this viscosity was too large to be explained by the carbohydrate concentration as determined with anthrone (see Table III). It was, therefore, attributed to soluble pentosans of considerable chain length which would affect the polyhexose anthrone color very little (see Table II) and would not be accounted for in the analysis. This view is supported by the substantial amount of hexose carbohydrate found in the extracted bleached kraft and unbleached sulphite concentrates although the residual viscosity was practically zero. The analytical result was probably due to suspended cellulose, and pentosans having been removed in the extraction.

Although boiling water-extracted pulps would be preferable in applying the viscometric analytical technique, unextracted pulps were used in order to obtain data comparable with the anthrone analyses. This necessitates a correction for the residual viscosity when sorption samples are analyzed. A modified form of the Arrhenius equation is applicable to such computations. It may be shown that the relative viscosity of two solutes dissolved in a given volume of liquid may be obtained from the relationship:

$$\log \eta_{rm} = \log \eta_{r1} + \log \eta_{r2}$$

where

η_{rm} = relative viscosity of the mixture
η_{r1} = relative viscosity component 1
η_{r2} = relative viscosity component 2

or more specifically

$$\log \eta_{rmc} = \log \eta_{rm} - \log \eta_{rp}$$

where

η_{rmc} = relative viscosity of the methylcellulose
η_{rm} = viscosity of the mixture
η_{rp} = residual relative viscosity of the pulps

EXPERIMENTAL RESULTS

A comparison of some typical results with several of the techniques described is of interest. Figure 6 shows the relation between analytical results obtained with anthrone using Celite and fritted glass and with the viscometric method in the sorption of methylcellulose by a West Coast bleached sulphite pulp. Filtrations of the bleached sulphite samples were generally made on the supernatant centrifugate, although a few filtrations were made directly on the supernatant liquor. Viscosities were run on both the supernatant liquor and the supernatant centrifugates (the results are essentially the same with either technique). Correction for residual viscosities were made, using the data of Table III and the modified Arrhenius viscosity equation given above.

From Fig. 6 it may be seen that, although there is excellent correlation between the anthrone and viscometric analyses, the results by the two methods do not exactly agree. The difference between methods

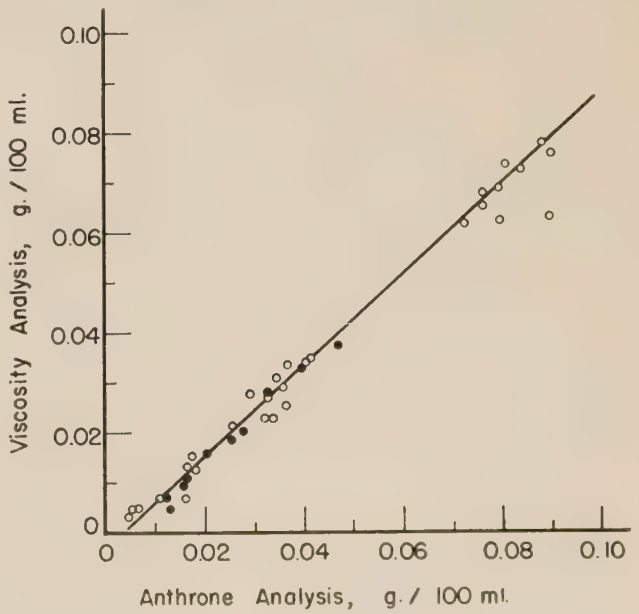

Fig. 6. Comparison of anthrone and viscosity analytical techniques

Bleached sulphite pulp, ○ Anthrone Celite technique, ● Anthrone fritted glass filtration technique.

is about 25% of the average in the lower ranges of concentration and about 10% in the higher. However, these small differences result in computed sorptions for the viscosity technique which are 1.5 to 2 times that obtained with the anthrone analysis. This large discrepancy in sorptions is due to the method of computing from small absolute differences in concentration. As was mentioned earlier, measurement of sorption by concentration difference demands very high accuracy in concentration measurements.

The reason for this analytical disparity is not known. The most likely explanation seems to be that the concentration and size of supernatant cellulose fines are greater in the presence of methylcellulose than in the presence of water alone, because of the deflocculating effect of methylcellulose shown by Erspamer (*13*). This being so, then it may be hypothesized that filtration does not completely remove the cellulose fines in the presence of methylcellulose, thus resulting in an equilibrium concentration which is too high. In turn the calculated sorption is too low.

The viscosity technique appears to give a more absolute measure of the equilibrium concentration than anthrone with Celite or fritted glass filtration. As will be shown in a subsequent paper, the molecular weight of methylcellulose does not influence retention by pulps. Furthermore, the pulp residual viscosity has been found to be independent of the methylcellulose present—i.e., log viscosities are additive as required by the modified Arrhenius equation. From these data it may be concluded that the viscometric technique gives a true measure of methylcellulose concentration.

Considerable variability in calculated sorptions was found with both the anthrone and viscometric analytical techniques. One of the main reasons for the variation is the difficulty in obtaining uniform small samples from pulp stored at 16 to 30% consistency. The fine fraction of a dilute pulp suspension tends to concentrate at the septum in dewatering by filtration and high consistency pulp when mixed, forms small lumps which probably are not uniform. Since sorption has been found to be a function of pulp surface, a uniform distribution of fiber fines is essential. Sample uniformity could be improved by taking well-mixed dry samples of pulp but irreversible drying effects would complicate sorption studies. However, extreme care in dewatering well-mixed dilute pulp suspensions so as to avoid concentration of fiber fines should result in a fairly uniform pulp. In the case of the anthrone analytical method, the variability may also be influenced by any variability in the action of the filters in removing suspended cellulose.

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The Proportion of Water-Accessible and Nonaccessible Cellulose in Wood Pulps as Affected by Beating

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A study of the effect of beating indicates that either no changes in the ratio of the accessible to nonaccessible cellulose in wood pulps result upon beating or that, if such changes do occur, they are masked by the variations inherent in the procedure used (moisture regain values).

The method of determining the water-accessible and nonaccessible portions of cellulose based on moisture-regain values has been described by Heath and Johnson (*1*). Using this method a study was undertaken to determine whether or not changes occur in the ratio of accessible to nonaccessible cellulose in wood pulps that have been subjected to beating.

Briefly, the method consists of measuring the gain in weight of samples suspended in closed vessels in atmospheres of known relative humidity, which are controlled

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Table I. Water-Accessible Portion of Commercial Wood Pulps Calculated from Absorption Moisture Regain

Sample	*Beating time, min.*	*M*	α	β	$\alpha\beta$	*Inaccessible, %*	*Accessible, %*	*Inaccessible accessible ratio*
Unbleached Douglas-fir kraft	0	314	0.0076	8.5	0.065	48.4	51.6	1.07
Unbleached Douglas-fir kraft	10	296	0.0074	9.4	0.070	45.3	54.7	1.21
Unbleached Douglas-fir kraft	20	315	0.0076	10.3	0.073	48.6	51.4	1.06
Unbleached Douglas-fir kraft	30	310	0.0075	10.1	0.071	47.7	52.3	1.10
Unbleached western hemlock kraft	0	317	0.0076	9.9	0.075	48.9	51.1	1.04
Unbleached western hemlock kraft	10	340	0.0079	9.3	0.073	52.4	47.6	0.91
Unbleached western hemlock kraft	20	323	0.0076	8.6	0.065	49.8	50.2	1.01
Unbleached western hemlock kraft	30	314	0.0077	12.1	0.093	48.4	51.6	1.07

Table IIA. Moisture Regain at 73°F. of Douglas-Fir Kraft Pulps

(As grams of water per 100 grams of phosphoric anhydride-dried sample)

Beating time, min.		*Percentage relative humidity* 11.1	32.9	48.6	64.8	75.5
0	1	3.1	5.9	7.7	10.2	12.4
	2	2.8	5.6	7.5	9.9	12.3
	Av.	2.9	5.8	7.6	10.1	12.4
	Calcd.	2.92	5.81	7.66	10.12	12.40
10	1	3.2	6.1	7.9	10.5	12.6
	2	3.2	6.1	8.0	10.3	12.2
	Av.	3.2	6.1	8.0	10.4	12.4
	Calcd.	3.19	6.18	8.11	10.60	12.82
20	1	3.3	6.1	7.9	10.4	12.7
	2	3.1	5.9	7.8	10.2	12.3
	Av.	3.2	6.0	7.9	10.3	12.5
	Calcd.	3.17	6.02	7.86	10.30	12.59
30	1	3.1	5.8	7.7	10.2	12.4
	2	3.3	6.1	8.0	10.5	12.5
	Av.	3.2	6.0	7.9	10.4	12.5
	Calcd.	3.18	6.05	7.91	10.31	12.51

Table IIB. Moisture Regain at 73°F. of Western Hemlock Kraft Pulps

(As grams of water per 100 grams of phosphoric anhydride-dried sample)

Beating time, min.		*Percentage relative humidity* 11.1	32.9	48.6	64.8	75.5
0	1	3.2	6.0	8.0	10.4	12.6
	2	3.0	5.7	7.6	10.1	12.3
	Av.	3.1	5.9	7.8	10.3	12.5
	Calcd.	3.10	5.93	7.78	10.21	12.48
10	1	2.6	5.3	7.3	9.8	11.8
	2	3.1	5.8	7.6	9.9	12.5
	Av.	2.9	5.6	7.5	9.9	12.2
	Calcd.	2.89	5.60	7.49	9.93	12.29
20	1	3.2	6.0	7.9	10.4	12.4
	2	2.5	5.2	7.1	9.6	11.6
	Av.	2.9	5.6	7.5	10.0	12.0
	Calcd.	2.85	5.65	7.59	9.91	12.15
30	1	3.5	6.2	8.0	10.5	12.6
	2	3.5	6.2	8.1	10.7	12.7
	Av.	3.5	6.2	8.1	10.6	12.7
	Calcd.	3.44	6.26	8.12	10.63	12.97

The percentage accessible and nonaccessible portions of cellulose are then calculated by applying the moisture regain data to the equation expressing the isotherm of a cellulose-type polymer, derived by Hailwood and Horrobin (*4*). Assuming the formation of a monohydrate, this equation has the form:

$$\frac{Mr}{1800} = \frac{\alpha h}{1 - \alpha h} + \frac{\alpha\beta h}{1 + \alpha\beta h}$$

in which M is the "molecular weight" of the operative polymer unit, r is the moisture regain in grams per 100 grams of dry sample, h is the percentage relative humidity, and α and β are constants.

The percentages of accessible and of nonaccessible cellulose for two kinds of wood pulps were determined. Each of the pulps had been subjected to beating in a laboratory beater for 10, 20, and 30 minutes. Determinations were also made on the original unbeaten material. The samples were taken from handsheets of unbleached kraft pulps made from Douglas-fir and western hemlock.

Table I gives the calculated values for M, the "molecular weight" of the operative polymer unit, α, β, and $\alpha\beta$ (all constants), the percentage inaccessible and accessible cellulose portions in these pulps, and, finally, the ratio of inaccessible to accessible material. No consistent relationships for any of these values with beating time were observed. In fact, variations were so irregular that they suggest differences in the portions of accessible and nonaccessible cellulose within the handsheets from which they were taken. This same observation was made by other investigators after extended use of the procedure at The Institute of Paper Chemistry.

Tables IIA and IIB show the moisture regain values obtained experimentally, and those calculated by making use of the equation of Hailwood and Horrobin.

Table III. Calculated Moisture Values at 100% Relative Humidity and 73°F.

(Grams per 100 grams phosphoric anhydride-dried sample)

Sample	*Beating time, min.*	*Total water*	*Free dissolved water*	*Hydrate water*	*Hydrate water ÷ accessible fraction*
Douglas-fir kraft	0	23.08	18.12	4.96	9.6
Douglas-fir kraft	10	22.63	17.31	5.32	9.7
Douglas-fir kraft	20	23.17	18.10	5.07	9.9
Douglas-fir kraft	30	22.55	17.42	5.13	10.8
Western hemlock kraft	0	22.99	17.98	5.01	9.8
Western hemlock kraft	10	24.57	19.91	4.66	9.8
Western hemlock kraft	20	22.51	17.67	4.84	9.6
Western hemlock kraft	30	23.58	18.40	5.18	10.0

by saturated salt solutions placed at the bottom of the containers. This technique was proposed by Gane (*2*) and later perfected and described by Wink (*3*).

The following saturated salt solutions were used:

	Relative humidity at 73°F., %
Lithium chloride	11.1
Magnesium chloride	32.9
Potassium nitrite	48.6
Sodium nitrite	64.8
Sodium chloride	75.5

Moisture absorptions were determined on duplicate samples as indicated in Tables IIA and IIB.

The calculated moisture regain at 100% relative humidity is presented in Table III. This moisture is divided into two components: the free dissolved water and the hydrate or adsorbed water. It is interesting to note the consistency of the value obtained by dividing the hydrate water regain (at 100% relative humidity) by the accessible fraction of cellulose in the sample.

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Chlorine Dioxide and Alkaline Peroxide in Kraft Bleaching

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A comparison has been made of the effect of acidified sodium chlorite, chlorine dioxide, alkaline peroxide, and calcium hypochlorite solutions as final bleaching agents for a southern pine kraft pulp preliminarily bleached by the conventional chlorination-extraction-hypochlorite method. The bleached pulps have been compared chiefly from the standpoint of viscosity, strength, and brightness permanence. The merits and limitations of each of these bleaching agents are pointed out. A new process is suggested for arriving at a bleached product of improved properties by the use of these chemical compounds in proper sequence. Observations are also reported on the relationship between the strength of bleached pulp and its cuprammonium viscosity.

THE past quarter-century has witnessed the development of many processes for the bleaching of kraft pulps, all of which have had as their aim the preparation of a pulp of high brightness and high paper-making strength properties. Practically all of the processes which have been used commercially to any extent have been based on the use of a hypochlorite as the bleaching agent, due largely to the low price of chlorine as compared with other effective bleaching agents. Very recently, however, there has been a growing interest in several other types of bleaching agents, principally chlorine dioxide and alkaline peroxide.

Chlorine dioxide has been of at least theoretical interest to technical men in the pulp bleaching field ever since Schmidt and Graumann (*1*) in 1921 demonstrated that solutions containing chlorine dioxide could be used to remove lignin and other incrustants from cellulosic material without injury to the cellulose. Patents were issued to Hamburger and Kaesz (*2*) a few years later on the use of chlorine dioxide for the bleaching of cellulose fibers and other organic material. Viscosity measurements by Staudinger and Jurisch (*3*) on cotton treated with a solution of chlorine dioxide revealed only a small drop in D.P. (degree of polymerization) indicating very little degradation of the cellulose. All of the above work was done with solutions prepared by dissolving in water the chlorine dioxide gas generated by the reduction of a chlorate, usually with oxalic acid as the reducing agent. Bray (*4*), Laséque (*5*), and Bruni and Levi (*6*) had shown that chlorine dioxide could also be formed by acidifying solutions of chlorites. However, it was not until sodium chlorite was made commercially available in the United States that work was first carried out by Taylor and White (*7*) and others employing acidified chlorite solutions as sources of chlorine dioxide for the bleaching of pulp.

The bleaching of cellulosic materials with alkaline peroxide solutions on an industrial scale has until recently been limited largely to the treatment of cotton textiles. In recent years, the use of this bleaching agent for the brightening of groundwood pulp has attracted considerable interest. In 1930, Bradley and McKeefe (*8*) suggested the use of sodium peroxide after a preliminary treatment with chlorine or hypochlorite in bleaching kraft and other chemical pulps. Scheller (*9*) then proposed the use of an alkaline extraction treatment between the two steps and later (*10*) added a hypochlorite stage immediately preceding the final step with peroxide. Alkaline peroxide solution was found by Staudinger and Jurisch (*3*) to have less degrading action on cotton than did hypochlorite, as indicated by viscosity measurements. However, its action was not as mild as that of chlorine dioxide.

The work described in the present report was carried out to study the relative merits of chlorine dioxide and alkaline peroxide as final bleaching agents in the treatment of kraft pulp. As a result of this study, a process was developed for the preparation of superior quality bleached pulps, the novelty of which has been recognized by the issuance of patents to the authors (*11*).

EXPERIMENTAL METHODS

General

The pulp chosen for this work was an air-dry unbleached southern pine kraft pulp having a permanganate number of 17.6, a brightness of 22.3, and a cuprammonium viscosity of 65.5 cp.

For the sake of convenience and brevity, the following code letters will be used in designating the sequence of stages in the various bleaching processes:

C = Chlorination
E = Caustic soda extraction
H = Calcium hypochlorite bleach
S = Sodium chlorite bleach
D = Chlorine dioxide bleach
P = Alkaline peroxide bleach

All figures expressed in percentage are based on the air-dry weight of pulp.

Experimental Procedure

The pulp, in batches of 2100 grams of air-dry fiber, was thoroughly defibered in the 5-pound laboratory beater and, after draining on a Monel metal screen, was transferred to a rubber-lined tumbler-type chlorinator along with the predetermined quantity of dilution water of the correct temperature to obtain a pulp consistency of 3.5% and a temperature of 75°F. The cover was fastened on, the chlorinator rotated at 20 r.p.m. and chlorine gas from a 1-pound liquid-chlorine cylinder was introduced through a hollow shaft by means of a hard-rubber piping connection.

The treatments with caustic soda and with the various bleaching agents were carried out in stationary stoneware crocks immersed in a hot-water bath. The quantity of chemical solutions to be added and the correct

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volume and temperature of water required to give the desired pulp consistency and temperature were calculated. In the caustic extraction and the hypochlorite treatments, the chemical reagents were diluted with the hot water, the solution then added to the pulp, and the whole mixed thoroughly by hand using a long rubber glove. In the chlorine dioxide treatment, the chlorine dioxide solution was introduced through a long tube into the bottom of the crock while the pulp was being stirred vigorously by hand. In this way, loss of ClO_2 gas was kept at a minimum. In the case of the chlorite and peroxide treatments the activating agents—sulphuric acid and caustic soda, respectively, were added after the bleaching agent had been thoroughly mixed with the pulp.

At the end of each treatment, the pulp was dumped on the Monel screen, washed thoroughly with tap water, rinsed in the beater, and finally pressed to about 35% consistency in the fruit press. The press cake was broken up by hand, and the crumbled pulp mass was then carefully mixed and divided into the desired number of batches for further treatment. In the case of the final bleached pulp, a moisture test was run on a sample of the pulp so that the desired quantities could be weighed out for beater processing and for the preparation of the various handsheets.

Test Methods

Brightness determinations were made on the General Electric reflectometer using the No. 1 filter in accordance with TAPPI Standard T 217 m-45. Pulp handsheets for brightness tests were prepared according to TAPPI Standard T 218 m-45. Viscosity determinations were made by the cuprammonium procedure described in TAPPI Standard T 206 m-44 and the alpha-cellulose content was determined according to TAPPI Standard T 203 m-44. Mullen bursting strength and Elmendorf tearing-resistance values were obtained on handsheets made during the beater processing of the pulps by the method of TAPPI Standard T 200 m-45 and conditioned in accordance with TAPPI Standard 402 m-44. The "average strength value" was obtained by averaging the burst and tear values.

In the absence of standard methods for the purpose, the degree of brightness permanence of the pulp was evaluated by means of three empirical tests:

Storage test—a measure of the degree of brightness permanence upon storage under standard atmospheric conditions. Handsheets were stored in the dark at a temperature of 72 °F. and a relative humidity of 50% for a period of exactly 8 weeks, and then tested again for brightness.

Light test—a measure of the degree of brightness permanence on exposure to ultraviolet light. Handsheets were exposed at a distance of 16 inches for 1 hour to the light from a General Electric 250-watt type H-5 mercury vapor lamp, and then checked again for brightness.

Heat test—a measure of the brightness stability on exposure to heat. The handsheets were suspended in an electrically-heated oven at a temperature of 100 °C. for 1 hour. The loss in brightness was then determined.

PRELIMINARY BLEACHING TREATMENT

The preliminary bleaching of the pulp used in experiments nos. 1 to 8 inclusive was carried out by means of a three-stage treatment consisting of (1) chlorination, (2) caustic soda extraction, and (3) calcium hypochlorite bleach or, in terms of the code, C-E-H. There are a number of sequences which could have been employed to satisfactorily accomplish the preliminary bleaching. The C-E-H sequence was chosen principally because it has found the widest acceptance in the industry and is perhaps better understood than any other process.

Table I. Data on Preliminary Bleaching (Common to Experiments I–VIII)

Stage 1 (Chlorination)	
Chlorine gas, %	4.85
Consistency, %	3.5
Temperature, °F.	75
Time-to-add gas, min.	5
Time-additional, min.	60
Residual Cl, %	0.21
Final pH	1.59
Stage 2 (Extraction)	
Caustic soda, %	1.5
Consistency, %	15.0
Temperature, °F.	150
Time, hr.	1.0
Residual NaOH, %	0.61
Stage 3 (Hypochlorite bleach)	
Caustic soda at start, %	0.40
Available chlorine, %	1.35
Consistency, %	5.0
Temperature, °F.	95
Bleaching time, hr.	2.5
Initial pH	10.5
Final pH	8.1
Residual Cl, %	0.14

The data concerning this treatment are shown in Table I, while the effect of each stage on the brightness and viscosity of the pulp is shown in Table II. In arriving at a brightness of 70.5 by this method, there was a drop of 50% in the viscosity figure. The attack occurred entirely in the chlorination and hypochlorite stages.

Table II. Effect of Preliminary Bleaching on Brightness and Viscosity

	Brightness	*Viscosity*
Unbleached	22.3	65.5
After stage 1	24.2	41.9
After stage 2	23.8	42.2
After stage 3	70.5	32.6

EXPERIMENTS IN FINAL BLEACHING

Experiment No. 1—Alkaline Extraction Plus Hypochlorite Bleach

Among five-stage bleaching processes for kraft pulp, the commercial process most widely used is the one employing the sequence: C-E-H-E-H. Consequently, this procedure was chosen for the first experiment. The results obtained thereby logically served as a basis for comparison with the procedures for final bleaching employed in subsequent trials. The data covering stages 4 and 5 of this sequence are listed in Table III.

Column 1 in Table IV shows the results obtained by this treatment. The final brightness was 84.1. The tests for brightness stability by the storage, light, and heat tests gave losses of 6.1, 6.1, and 5.1 points,

Table III. Experiment No. 1—Alkaline Extraction Plus Hypochlorite Bleach

Stage 4 (Extraction)	
Caustic soda, %	1.5
Consistency, %	15.0
Temperature, °F.	150
Time, hr.	1.0
Residual NaOH, %	0.96
Stage 5 (Hypochlorite bleach)	
Caustic soda at start, %	0.15
Caustic soda during bleach, %	0.10
Available chlorine, %	0.80
Consistency, %	5.0
Temperature, °F.	105
Bleaching time, hr.	5.0
Average pH	8.8
Residual Cl, %	0.27

respectively. Compared with the unbleached pulp, there was an over-all drop in viscosity of 70% and a loss of 12% in the average strength value.

Experiment No. 2—Alkaline Extraction Plus Chlorite Bleach

In the second experiment, acidified sodium chlorite was substituted for hypochlorite in stage 5 to give the sequence: C-E-H-E-S. The conditions used in this treatment are tabulated in Table V.

as compared with the unbleached pulp. The alpha-cellulose content was significantly higher than that of the hypochlorite bleached pulp. The tests for brightness permanence however, indicated no substantial improvement in this respect over the results obtained in experiment no. 1.

Experiment No. 3—Alkaline Extraction Plus Peroxide Bleach

In this instance, an alkaline solution of hydrogen peroxide was used as the bleaching agent in stage 5. The details of this treatment are given in Table VI.

Table VI. Experiment No. 3—Alkaline Extraction Plus Peroxide Bleach

Stage 4 (Extraction)	
Same as in experiment no. 1 (Table III)	
Stage 5 (Peroxide bleach)	
Caustic soda, %	0.40
Hydrogen peroxide, %	1.0
Consistency, %	15.0
Temperature, °F.	133–150
Bleaching time, hr.	6.5
Average pH	10.65
Residual H_2O_2, %	0.22

The results of this treatment are shown in column 3 of Table IV. It will be seen, first of all, that, in spite of the fact that the pulp was treated for an abnormally long period with an excessive quantity of peroxide, the final brightness was only 81.0. The tests for brightness stability show a marked improvement in this property. The storage, light, and heat tests gave losses of only 2.0, 3.8, and 2.8 points, respectively, compared with the substantially higher losses experienced in the previous two experiments. The values for viscosity, average strength, and alpha-cellulose indicate that peroxide attacked the pulp more than chlorite but that it was much less severe than hypochlorite. However, the fact that the final brightness was low must be taken into account in these considerations.

Table IV. Effect of Final Bleaching Treatment on Pulp Properties

Experiment No.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*Unbl.*
Process	C-E-H-E-H	C-E-H-E-S	C-E-H-E-P	C-E-H-H-P	C-E-H-S-P	C-E-H-D-P	C-E-H-S-S	C-E-H-SP	
Brightness:									22.3
After stage 4	61.8	61.8	61.8	80.7	81.4	80.4	81.5	81.5	
After stage 5	84.1	84.4	81.0	84.0	84.2	83.2	84.3	82.1	
Loss in brightness:									
Storage test—after stage 4	...	...	...	6.1	6.0	6.1	6.0	...	
Storage test—after stage 5	6.1	5.6	2.0	2.1	1.6	1.6	5.8	1.8	
Light test—after stage 5	6.1	6.0	3.8	4.5	3.5	3.7	6.0	3.6	
Heat test—after stage 5	5.1	4.8	2.8	3.3	3.0	3.0	4.7	3.1	
Viscosity, cp.:									65.5
After stage 4	31.8	31.8	31.8	21.4	34.0	32.4	34.0	34.0	
After stage 5	20.5	32.2	28.7	19.6	32.7	29.0	34.1	32.1	
Alpha-cellulose, %	87.55	88.78	88.52	87.60	88.70	88.68	88.56	88.62	
Strength data:									
Bursting strength at 45 min.	1.41	1.52	1.48	1.44	1.49	1.50	1.53	1.49	1.41
Bursting strength at 70 min.	1.52	1.69	1.68	1.57	1.67	1.70	1.72	1.69	1.61
Tearing resistance at 45 min.	1.96	2.13	2.10	1.93	2.20	2.18	2.19	2.21	2.44
Tearing resistance at 70 min.	1.75	2.03	1.99	1.72	2.05	2.04	2.03	2.02	2.12
Freeness at 45 min.	740	755	765	740	740	735	740	730	800
Freeness at 70 min.	450	460	485	440	505	495	480	470	540
Average strength value	1.66	1.84	1.81	1.66	1.85	1.85	1.87	1.85	1.89

Column 2 in Table IV shows the results obtained in this experiment. The pulp was bleached to substantially the same brightness as in experiment no. 1, but with practically no change in viscosity as compared with the preliminarily bleached pulp. The average strength value indicated only a slight drop in strength

Table V. Experiment No. 2—Alkaline Extraction Plus Chlorite Bleach

Stage 4 (Extraction)	
Same as in experiment no. 1 (Table III)	
Stage 5 (Chlorite bleach)	
Sulphuric acid, %	0.75
Available chlorine, % (as sodium chlorite)	0.80
Consistency, %	5.0
Temperature, °F.	150
Bleaching time, hr.	2.0
Average pH	3.85
Residual Cl, %	0.22

Experiment No. 4—Hypochlorite Bleach Plus Peroxide Bleach

In view of the fact that peroxide failed to give the

Table VII. Experiment No. 4—Hypochlorite Bleach Plus Peroxide Bleach

Stage 4 (Hypochlorite bleach)	
Caustic soda at start, %	0.20
Caustic soda during bleach, %	0.08
Available chlorine, %	0.80
Consistency, %	5.0
Temperature, °F.	105
Bleaching time, hr.	5.0
Average pH	8.8
Residual Cl, %	0.26
Stage 5 (Peroxide bleach)	
Caustic soda, %	0.40
Hydrogen peroxide, %	0.24
Consistency, %	15.0
Temperature, °F.	140–150
Bleaching time, hr.	4.0
Average pH	10.75
Residual H_2O_2, %	0.06

desired final brightness in experiment no. 3, it was felt advisable to run a trial in which a second hypochlorite bleach was substituted for the alkaline extraction in stage 4, giving the sequence: C-E-H-H-P. The conditions employed in this experiment are disclosed in Table VII.

Referring now to column 4 in Table IV, it will be seen that the desired final brightness was obtained by this procedure; also that the permanence of the brightness was almost as satisfactory as that obtained in the previous experiment with peroxide. However, the viscosity, strength, and alpha-cellulose values were very similar to those obtained in experiment no. 1, the other experiment in which two hypochlorite treatments were employed. A storage test run on the pulp after stage 4 gave a loss of 6.1 points, demonstrating the fact that the improved final permanence was due to the peroxide treatment.

The conclusion may be drawn from this experiment that, while this particular sequence; i.e., C-E-H-H-P, can be relied upon to give improved brightness permanence, the strength properties of the product are no better than those of the pulp produced by the conventional commercial process; i.e., C-E-H-E-H.

Experiment No. 5—Chlorite Bleach Plus Peroxide Bleach

In this case, acidified sodium chlorite was used in stage 4 in place of the hypochlorite employed in experiment no. 4, to give the sequence: C-E-H-S-P. The data concerning this experiment are given in the first column of Table VIII.

Table VIII. Experiments Nos. 5 and 8—Chlorite Bleach Plus Peroxide Bleach

	Experiment No. 5	*Experiment No. 8*
Stage 4 (Chlorite bleach)		
Sulphuric acid, %	0.60	0.60
Available chlorine, % (as sodium chlorite)	0.80	0.80
Consistency, %	5.0	5.0
Temperature, °F.	150	150
Bleaching time, hr.	3.5	3.5
Average pH	4.1	3.9
Residual Cl, %	0.19	0.16 (no washing)
Stage 5 (Peroxide bleach)		
Caustic soda, %	0.40	1.20
Hydrogen peroxide, %	0.12	0.12
Consistency, %	15.0	5.0
Temperature, °F.	140–150	150
Bleaching time, hr.	3.0	3.5
Average pH	10.9	10.8
Residual H_2O_2, %	0.02	0.02

Data on the product obtained by this procedure are tabulated in column 5 of Table IV. Compared with experiment no. 4, it will be seen that this sequence gave the desired final brightness with only half the amount of peroxide in stage 5. Furthermore, the brightness stability was substantially improved and was the best among the pulps produced in this group of experiments. Again the storage test after stage 4 showed that the high permanence of the final product was attributable to the peroxide treatment.

The viscosity, average strength, and alpha-cellulose values were substantially the same as in experiment no. 2 in which the C-E-H-E-S sequence was used. The final bleaching treatment resulted in substantially no attack on the fiber.

Table IX. Experiment No. 6—Chlorine Dioxide Bleach Plus Peroxide Bleach

Stage 4 (Chlorine dioxide bleach)	
Available chlorine, % (as chlorine dioxide)	0.85
Consistency, %	5.0
Temperature, °F.	150
Bleaching time, hr.	3.5
Average pH	6.55
Residual Cl, %	0.19
Stage 5 (Peroxide bleach)	
Caustic soda, %	0.40
Hydrogen peroxide, %	0.12
Consistency, %	15.0
Temperature, °F.	140–150
Bleaching time, hr.	3.0
Average pH	11.0
Residual H_2O_2, %	0.02

From this experiment, it may be concluded that a treatment of the preliminarily bleached pulp with acidified chlorite leaves the pulp in a condition which permits the use of peroxide in a more efficient manner than when hypochlorite is used. Less peroxide is required for a given final brightness, a higher degree of permanence of the brightness is obtained, and the chemical and physical properties of the pulp are preserved.

Experiment No. 6—Chlorine Dioxide Bleach Plus Peroxide Bleach

A solution of chlorine dioxide in water was used as the bleaching agent in stage 4 in this instance, to give the sequence: C-E-H-D-P. The bleaching data are presented in Table IX. No attempt was made to control or modify the pH in the chlorine dioxide stage.

The results obtained in this experiment are shown in column 6 of Table IV. It will be noted that, compared with experiment no. 5 in which sodium chlorite was used, aside from a somewhat lower brightness and viscosity, the results are similar. The high degree of brightness stability was again obtained along with a low peroxide consumption and with good preservation of pulp strength.

It should be noted also that, in stage 4, a lower brightness was obtained with chlorine dioxide than with chlorite, in spite of the fact that more of the bleaching agent was used, in terms of available chlorine.

Experiment No. 7—Two Chlorite Bleaches in Succession

In order to establish definitely the merits of peroxide in stage 5, this experiment was run using chlorite in both stage 4 and stage 5 to give the sequence: C-E-H-S-S. The pertinent facts regarding this treatment are recorded in Table X.

Table X. Experiment No. 7—Chlorite Bleach Plus Second Chlorite Bleach

Stage 4 (Chlorite bleach)	
Same as in Experiment No. 5 (Table VIII)	
Stage 5 (Chlorite bleach)	
Sulphuric acid, %	0.40
Available chlorine, % (as sodium chlorite)	0.25
Consistency, %	5.0
Temperature, °F.	150
Bleaching time, hr.	1.5
Average pH	4.0
Residual Cl, %	0.05

The properties of the resulting pulp are listed in column 7 of Table IV. The only material difference between this pulp and that produced in experiment no. 5 is in the degree of brightness permanence. When two chlorite stages were used, the stability was no better than that obtained in experiments nos. 1 and 2. Again it is apparent that the peroxide stage is necessary if the higher degree of permanence is desired.

Experiment No. 8—Elimination of Wash Between Chlorite and Peroxide Stages

An additional experiment was run using conditions similar to those in experiment no. 5 with the exception that no washing step was used between the acidified sodium chlorite treatment and the alkaline peroxide stage. Of necessity, the pulp consistency in the peroxide stage was 5%, the same as that of the chlorite stage, contrasted with the higher consistency of 15% used in experiment no. 5. The bleaching data are shown in the second column of Table VIII.

By referring to column 8 of Table IV, it will be seen that the only significant effect of omitting the washing step was reduction of two points in final brightness. The amount of alkali required to maintain the desired pH in the peroxide stage was also materially higher. However, the brightness stability was approximately on a par with that obtained when the washing step was used.

Table XI. Experiment No. 9—Data on Four-stage Bleach

Stage 1 (Chlorination)	
Chlorine gas, %	4.85
Consistency, %	3.5
Temperature, °F.	75
Time—to add gas, min.	5
Time—additional, min.	60
Residual Cl, %	0.15
Final pH	1.55
Stage 2 (Hypochlorite bleach)	
Caustic soda at start, %	1.15
Available chlorine, %	2.5
Consistency, %	5.0
Temperature, °F.	95
Bleaching time, hr.	1.5
Initial pH	10.7
Final pH	8.0
Residual Cl, %	0.15
Stage 3 (Chlorite bleach)	
Sulphuric acid, %	0.60
Available chlorine, % (As sodium chlorite)	0.80
Consistency, %	5.0
Temperature, °F.	150
Bleaching time, hr.	3.0
Average pH	4.05
Residual Cl, %	0.11
Stage 4 (Peroxide bleach)	
Caustic soda, %	0.40
Hydrogen peroxide, %	0.12
Consistency, %	15.0
Temperature, °F.	140 to 150
Bleaching time, hr.	3.0
Average pH	10.9
Residual H_2O_2, %	0.024

Experiment No. 9—Omission of Alkaline Extraction Stage

Because the peroxide treatment had proved so efficacious in improving the brightness permanence of the pulp, the interesting possibility of employing a four-stage treatment without the use of an alkaline extraction stage presented itself. Consequently an experiment was run using the sequence: C-H-S-P; the results obtained thereby were then compared with the C-E-H-S-P sequence used in experiment no. 5. Table XI shows the set of data describing the four-stage bleach.

A comparison of the two columns in Table XII leads to the conclusion that omission of the alkaline extraction stage had no significant detrimental effect on the quality of the bleached pulp. The brightness permanence was for all practical purposes as good as when the extraction stage was used. The two pulps were practically identical with respect to their viscosity and average strength values. The slightly lower alpha content may be taken to indicate less loss of hemicelluloses because of the omission of the alkaline extraction stage.

COMPARISON WITH THEORETICAL STANDARD

General Considerations

The best bleached pulps obtained in the series of experiments just described possessed an average strength very nearly equal to that of the unbleached pulp. Their viscosity values, however, were only about half that of the unbleached pulp. If a sample of bleached pulp could be prepared having a viscosity similar to or not greatly lower than that of the unbleached pulp, it would be interesting to determine the strength properties of such a pulp. With this object in mind, two additional experiments were carried out in an effort to prepare such a standard pulp.

Experiment No. 10—Wise Holocellulose Treatment

Wise (*12*) has described a method for the preparation of holocellulose from unbleached pulp employing an acidified chlorite solution under a standard set of conditions. Because of the reported mild action of chlorine dioxide on cellulose, it was felt that the use of this procedure might result in a bleached pulp having a minimum reduction in viscosity. Experiment no. 10,

Table XII. Effect on Pulp Properties of Omitting Extraction Stage

	Experiment No.	
Process	*5* C-E-H-S-P	*9* C-H-S-P
Brightness		
After hypochlorite stage	70.5	70.5
After chlorite stage	81.4	81.0
After peroxide stage	84.2	84.4
Loss in brightness		
Storage test—after chlorite stage	6.0	6.3
Storage test after peroxide stage	1.6	1.8
Light test after peroxide stage	3.5	3.9
Heat test after peroxide stage	3.0	2.8
Viscosity, cp.		
After hypochlorite stage	32.6	31.9
After chlorite stage	34.0	33.2
After peroxide stage	32.7	32.5
Alpha-cellulose, %	88.70	88.51
Strength data		
Bursting strength at 45 min.	1.49	1.55
Bursting strength at 70 min.	1.67	1.69
Tearing resistance at 45 min.	2.20	2.15
Tearing resistance at 70 min.	2.05	2.05
Freeness at 45 min.	740	735
Freeness at 70 min.	505	470
Average strength value	1.85	1.86

Table XIII. Experiment No. 10—Wise Holocellulose Treatment

Amount of air-dry pulp		600 grams	
Acetic acid		60 ml. of 99.5% acid	
Sodium chlorite		180 grams $NaClO_2$	
Available chlorine, %		47.0	
Consistency, %		3.0	
Temperature, °F.		150	
Initial pH		4.1	
Bleaching time	35 min.	3 hr.	6 hr.
Final pH	4.3	4.4	4.5
Residual Cl, %	36.6	27.5	21.8

described in Table XIII, was carried out using Wise's holocellulose method.

The properties of the resulting pulp are listed in Table XIV. It will be seen, first of all, that, at the end of the prescribed time period of 35 minutes, the brightness was only 61.5. To obtain approximately the desired brightness of 84, it was found necessary to treat the pulp for 6 hours. The drop in viscosity was now 30% and the average strength value was equal to that of the unbleached pulp. The brightness permanence was poor, the loss in brightness by each of the tests being somewhat greater than that of any of the other pulps previously described.

The effect of continued treatment on the viscosity, the brightness, and the residual chlorite (in terms of available chlorine) is shown graphically in Fig. 1. The reduction in viscosity is, roughly speaking, directly proportional to the length of time of treatment. It appears that an extensive treatment of the pulp with the acidified chlorite solution results in depolymerization of the cellulose as evidenced by the magnitude of the reduction in viscosity.

Experiment No. 11—High Viscosity Standard Bleached Pulp

The holocellulose method was not considered quite satisfactory as a method of preparing a standard bleached pulp for comparison purposes for two reasons: (1) the drop in viscosity of 30% was greater than might be desired and (2) the brightness permanence was poor.

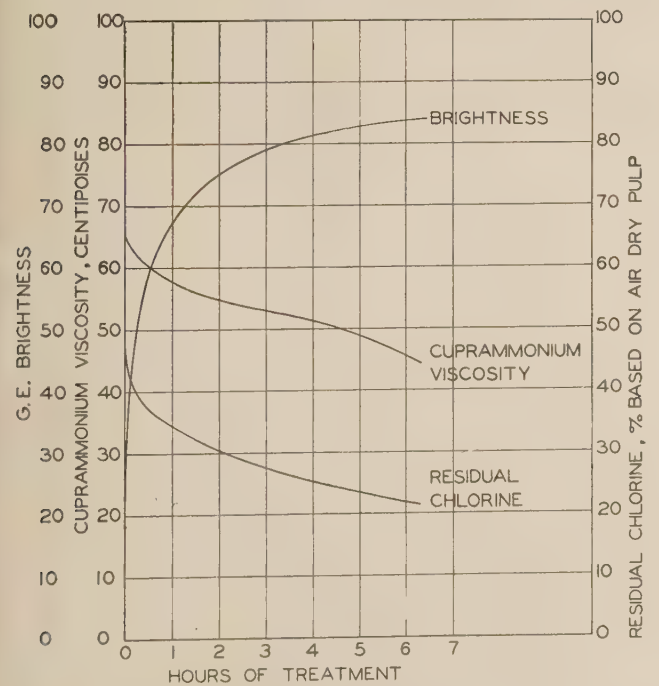

Fig. 1. Effect of extended treatment by the Wise holocellulose method

Table XIV. Experiment No. 10—Properties of Wise Holocellulose Pulps

	Bleaching time		
	35 min.	*3 hr.*	*6 hr.*
Brightness	61.5	78.9	83.7
Loss in brightness			
Storage test			6.8
Light test			6.4
Heat test			6.8
Viscosity, cp.	59.8	53.0	45.5
Alpha-cellulose, %			87.90
Strength data			
Bursting strength at 45 min.			1.52
Bursting strength at 70 min.			1.70
Tearing resistance at 45 min.			2.25
Tearing resistance at 70 min.			2.09
Freeness at 45 min.			730
Freeness at 70 min.			505
Average strength value			1.89

It was decided to try a four-stage treatment utilizing the advantages of the newly developed process. The steps consisted of (1) a mild sodium chlorite prebleach, (2) a light chlorination, (3) a second chlorite bleach, and (4) a peroxide bleach, the sequence being: S-C-S-P. The data concerning this treatment are shown in Table XV.

The results obtained by this procedure are given in Table XVI. The final brightness of 85 was of a very permanent character, the loss in brightness in the stability tests being somewhat less than that obtained in the best five-stage experiments. The reduction in viscosity was only 20%, and the strength of the pulp was equal to that of the unbleached pulp. The higher alpha-cellulose content as compared with the holocellulose method (experiment no. 10) may indicate that some alkali-soluble constituents were dissolved in the alkaline peroxide stage.

A surprising result in this experiment was the fact that the loss in viscosity in going to 44 brightness was greater, rather than less, than that which would have

Table XV. Experiment No. 11—Preparation of High Viscosity Standard Bleached Pulp

Stage 1 (Chlorite prebleach)	
Acetic acid, %	4.45
Available chlorine, % (as sodium chlorite)	6.0
Consistency, %	3.0
Temperature, °F.	140
Bleaching time, hr.	1.33
Average pH	3.95
Residual Cl, %	0.24
Stage 2 (Chlorination)	
HCl, % at start	0.43
pH at start	3.6
Chlorine gas, %	1.0
Consistency, %	3.0
Temperature, °F.	75
Time—to add gas, min.	10
Time—additional, min.	45
Final pH	2.3
Residual Cl, %	0.10
Stage 3 (Chlorite bleach)	
Acetic acid, %	2.0
Available chlorine, % (as sodium chlorite)	2.25
Consistency, %	5.0
Temperature, °F.	150
Bleaching time, hr.	3.0
Average pH	3.85
Residual Cl, %	0.16
Stage 4 (Peroxide bleach)	
Caustic soda, %	0.40
Hydrogen peroxide, %	0.12
Consistency, %	15.0
Temperature, °F.	150
Bleaching time, hr.	3.0
Average pH	10.75
Residual H_2O_2, %	0.026

Table XVI. Experiment No. 11—Properties of High-Viscosity Standard Bleached Pulp

	After stage 1	After stage 2	After stage 3	After stage 4
Brightness	44.3	44.6	80.6	85.1
Loss in brightness				
Storage test			6.6	1.0
Light test				2.9
Heat test				2.6
Viscosity, cp.	61.3	54.9	54.6	52.3
Alpha-cellulose, %				88.60
Strength data				
Bursting strength at 45 min.				1.52
Bursting strength at 70 min.				1.75
Tearing resistance at 45 min.				30
Tearing resistance at 70 min.				2.04
Freeness at 45 min.				765
Freeness at 70 min.				510
Average strength value				1.90

been expected if the holocellulose procedure had been used. It is probable that a bleached pulp of still higher viscosity could be prepared by further modifications of this treatment. For example, perhaps in the first step it may be preferable to use a 10-minute treatment by the Wise holocellulose method, and in stage 2 the loss in viscosity may be reduced by cutting down on the chlorine dosage. Possibly more work can be done in stage 3 without any great sacrifice in viscosity. A further possibility is the use of several short treatments with chlorite according to the method of Wise followed by a peroxide stage; e.g., the sequence S-S-P or S-S-S-P.

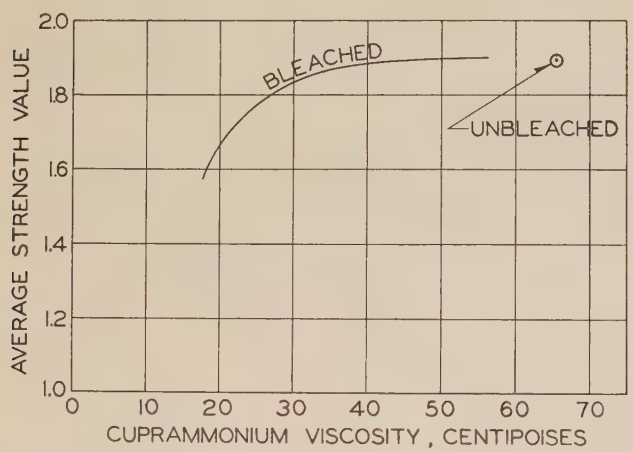

Fig. 2. General relationship between viscosity and average pulp strength

Figure 2 has been prepared to show the general relationship between viscosity and pulp strength. It will be readily seen that, in the case of this particular pulp, nothing is to be gained in the way of pulp strength by striving for a viscosity greater than about 40 cp. Furthermore, for all practical purposes, a pulp substantially as strong as the unbleached pulp is obtained in the range of about 30 to 40 cp. The drop in pulp strength as the viscosity falls below about 30 cp. is increasingly pronounced.

CONCLUSIONS

In considering various treatments for raising the brightness of a southern pine kraft pulp from 70.5 to 84, the following conclusions may be drawn from the above-described experiments:

1. A chlorite or chlorine-dioxide stage followed by an alkaline peroxide stage was the only treatment which gave the desirable combination of high brightness, high permanence of brightness, high strength, and minimum chemical requirement.

2. Chlorine dioxide solution, in the manner in which it was employed, gave slightly less satisfactory results than acidified chlorite.

3. Washing between the acidified chlorite and the alkaline peroxide stage proved to be desirable from the standpoint of peroxide and alkali requirement.

4. When this type of finishing treatment was used, it was found that the alkaline extraction stage in the preliminary bleaching could be eliminated with no detrimental effect on pulp quality.

5. Chlorite without a peroxide stage gave good pulp strength but a brightness permanence no better than that obtained with hypochlorite.

6. Peroxide imparted high permanence to the brightness, but was only practicable after the pulp had been bleached by other means to within a few points of the desired final brightness.

7. There was a surprising reduction in the peroxide requirement when acidified chlorite or chlorine dioxide was used instead of hypochlorite prior to the peroxide stage.

8. The preparation of bleached pulps of exceptionally high viscosity by means of special laboratory treatments served to demonstrate that no improvement in pulp strength was obtainable by going to viscosities above approximately 40 cp. Pulps very nearly equal in strength to the unbleached were obtained in the range of 30 to 40 cp.

9. The conventional five-stage process employing only hypochlorite as the bleaching agent gave a pulp of 20 cp. viscosity and having an average strength value 12% lower than the unbleached.

It is the hope of the authors that the findings described in this report, in addition to supplementing in a small way the sum total of knowledge concerning the art of kraft bleaching, shall serve to stimulate further research along such lines as (1) the development of standard methods for determining brightness permanence, (2) a more extensive study of the relationship between viscosity and the various strength properties of the pulp sheet, and (3) the chemical explanation for the higher degree of permanence obtained with peroxide solutions as compared with the other bleaching agents.

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The Accessibility of Cellulose

HAROLD TARKOW

Sections of cellulose chains laid down in the cell wall occur in regions ranging from those having high lateral order, through regions of decreasing order, to regions of haphazard orientation. When produced by regeneration, the lateral order, at best, is low. Because of the gradual transition in lateral order, the term *crystalline fraction* is not a too-well defined term. Different methods for measuring crystallinity may give varying results, depending on how each method interprets the crystalline-noncrystalline pattern. Crystallinity as measured by x-ray diffraction is a measure of the fraction having at least a certain degree of lateral order. The method is direct. The method based on density determination is not an independent one, since it assumes that the ratio of the densities of crystalline and amorphous cellulose is the same as that of crystalline and amorphous butyl alcohol. The chain arrangement influences the course of cellulose reactions. The fraction of readily accessible material can be determined. It is questionable, however, whether the noncrystalline material is necessarily identical with the readily accessible material, since the reactivity may be influenced by additional factors. These include (1) degree of preswelling, (2) possibility of recrystallization, (3) size of reactant molecule, (4) presence of junction points, and (5) reactivity of surfaces of crystalline regions. The methods involving deuterium exchange, reaction with sodium, and analysis of adsorption isotherms give accessibility values in reasonable agreement. Recently a new method has been proposed, based on the ability of formic acid to react only with the primary hydroxyl group in the anhydroglucose residue. A relatively noncrystalline material like starch forms only a monoformate. Different celluloses acquire formyl contents less than that for a monoformate, with the values decreasing appreciably between that for rayons and that for native cellulose. The deviation from the monoformate is ascribed to the nonaccessibility of some of the primary groups. The ratio of the formyl content to that for a monoformate is assumed to be the fraction of readily accessible material. The values are in agreement with those obtained with the other nondestructive chemical methods. Accessibility determined by these chemical methods tells nothing about the absolute reactivity of the more difficultly accessible regions; therefore, such measurements by themselves do not characterize the chemical convertability of a cellulose.

IT HAS been lightly said that a subject has reached maturity when it has acquired a specialized nomenclature. On such a basis, the subject under consideration should be considered mature, since it involves terms such as crystallinity, amorphous, availability, accessibility, order, disorder, degree of disorder, deranged order, organized area, orientation, alinement, etc. Unfortunately, however, all these terms are not clearly defined, so that some confusion has arisen concerning their measurement and use. To some, for example, the terms "crystallinity" and "orientation" have different meanings; to others, they are synonymous. Confusion also exists with regards to the words "amorphous" and "accessible." This paper discusses some of these terms and considers their quantitative evaluation. It attempts, first, to present a mental picture of the subject.

Figure 1 shows in a highly schematic manner some of the possible arrangements of sections of cellulose chains. Each parallelepiped represents a section of a long chain whose other sections may or may not be haphazardly arranged. In native cellulose, the chains are laid down (perhaps enzymatically) so that occasionally sections of them run parallel to each other (Fig. 1, *A*, *B*, and *C*). In some of these regions, further orientation of sections may occur, with respect to functional groups, that may result in truly crystalline regions or regions of high degree of lateral order. Thus, in *A* there are repeating atomic planes along the three coordinate axes. In other regions of parallelism there may be repeating distances along only two (*B*), one (*C*), or none (*E*) of the axes. *B* and *C* represent two- and one-dimensional crystals, respectively. Actually, the distribution of deviations from *A* is broad, so that the terms "intermediate" and "low degree of lateral order" are used. Baker uses a converse term, "degree of disorder" (*2*). In *D*, the chains are only approximately parallel. The configuration in *A* is unique. It has a definite density and produces a sharp x-ray diffraction pattern. The other regions are indefinite and perhaps infinite in number. Shall they be called noncrystalline, or how low must the lateral order be before a region can no longer be called crystalline? This is an important question, for quite likely different procedures give somewhat different values for crystallinity (or accessibility), depending on how many of the imperfect regions each includes with the perfect regions. In *C*, it is seen that although the orientation with respect to section length may be perfect, owing to the low degree of lateral order the degree of crystallinity is very low. Orientation, when referring to the effect of drawing or stretching, refers to the statistical distribution with respect to length alinement of all glucose residues regardless of whether they occur in crystalline or noncrystalline regions. Crystallinity is concerned with the existence of lateral order among parallel chains (*8*).

When laid down in the cell wall, many of the noncrystalline regions are permeated by water. One might ask how low the regions of lateral order must be before they, too, are permeated. Unfortunately, no answer can be given. On drying, owing to the length of the chains and their limited flexibility, it is not very likely that the amount of high-order or even low-order crystallinity is appreciably increased. Individual chain sections will distort, convolute, and make occasional contacts, some of which may be permanent, yet because these junctions are not part of a repeating system, they contribute little to the total crystallinity, even though their presence may profoundly effect some fiber proper-

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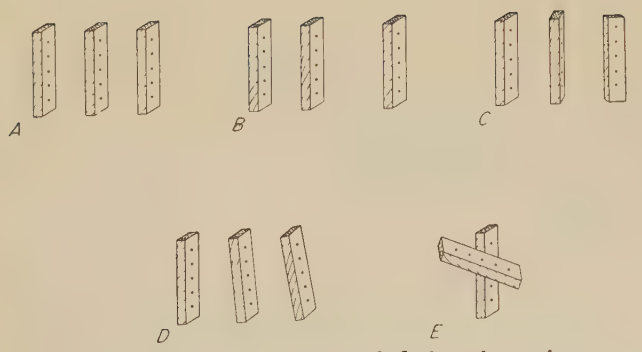

Fig. 1. Schematic drawing of chain orientation

ties, including reactivity. Thus, the crystalline pattern is very likely fixed at the birth of the cell wall.

In the rayon mill, an attempt is made to improve on nature. Raw cellulose is dissolved, gelled, decomposed, dried, and stretched. Owing to the rapidity with which gelation occurs, and owing to the sluggish diffusion tendencies of the chains, the crystalline regions are quite small and generally of low degree of lateral order. Kratky (*14*) believes that the crystalline pattern is fixed during gelation. Subsequent processing has little added effect. There is some indication that the crystalline regions in regenerated celluloses can be permeated by water.

This, then, is our mental picture of cellulose. It is admittedly blurred. There is ambiguity in distinguishing crystalline from noncrystalline regions because of the gradual transition between the two. The ambiguity is especially great in regenerated celluloses, yet the terms crystalline and noncrystalline are used as though cellulose contained two such unique entities.

Theoretically, the most unambiguous way for measuring the amount of crystalline matter is by x-ray diffraction. A method, developed by Hermans (*11*), measures the total amount of material having at least some lateral order. On this basis, he finds that all native celluloses have about 70% crystalline matter; whereas all regenerated celluloses have about 35%. The latter remains constant, regardless of the composition of the solvent of precipitating bath. On examining the x-ray diffraction patterns in great detail, however, Hermans (*10*) finds that although the total crystallinity is the same for all rayons, the distribution of regions of different degrees of lateral order varies from rayon to rayon. In other words, the nature of the crystalline material, and not the total amount, varies from rayon to rayon.

Hermans (*9*) has pointed out that the over-all density of a fiber measured with a nonpenetrating fluid should vary with its crystalline content. He put this view on a quantitative basis by assuming the presence of two components, each having its own unique density: a three-dimensionally perfect crystalline region, whose density is accurately known from x-ray data, and a noncrystalline region whose density can only be suggested by indirect means. He notes from the work of Biltz (*3*) that the density of crystalline butyl alcohol is 6% greater than that of the glassy material, and he makes the assumption that a similar difference exists between crystalline and noncrystalline cellulose. He calculates 60 and 25% crystalline content in ramie and regenerated cellulose, respectively. The agreement with the x-ray-determined values is seemingly good. They would be more acceptable, however, if it were not for the assumption concerning the density of noncrystalline cellulose. Biltz also includes the densities of crystalline and glassy ethyl alcohol. Here the difference is only 3%. If this figure is used in the calculation, ramie is found to have a crystalline content of 25%. This is obviously low, yet why is one justified in using the butyl alcohol figures? Stretching rayon increases the density very slightly. This is not reflected in an increase in x-ray-determined crystallinity, and it may be due to the fact that, whereas stretching increases the degree of packing of noncrystalline regions, it does not improve their lateral order.

Chemically, cellulose behaves like an alcohol and glycoside. The physical arrangement of the chains, however, can have a marked influence on the manner in which cellulose reacts; so much so, that it is believed by some that by studying the course of the reaction one can learn something about the chain arrangement. It is not certain, however, whether the part reacting rapidly is generally identical with the noncrystalline matter measured by x-rays, since there are other factors that may influence the extent or rate of reaction.

Perhaps the most important of these is concerned with the ability of the reactant to penetrate the cellulose. Reeves (*16*) found that only 0.4% of methoxyl is introduced when diazomethane reacts with oven-dry cotton, while 9% methoxyl is introduced if the cotton has an initial moisture content of 6%. Which of these two methoxyl contents comes closer to measuring the amount of noncrystalline matter? Since there is no change in crystallinity on drying cellulose, the difference between the two values is not due to a difference in crystalline contents; rather, it is due to the inability of the reactant to push apart those haphazardly oriented chains in oven-dry cotton, e.g., it is unable to swell or diffuse through the noncrystalline regions. This diffusion is greatly facilitated even though the cellulose is only partly swollen in water. This was beautifully shown by Hermans (*7*) in his work on the diffusion of glycerine through dry and water-swollen rayons. How much should the cellulose be swollen before the subsequently measured degree of reaction comes closest to measuring the amount of amorphous matter? Since the crystalline-noncrystalline pattern was established originally in an aqueous system, it would seem that a good approximation of this pattern should be obtained by examining the reaction of cellulose swollen at least by the amount it would swell in liquid water. It is conceivable that in some instances a cellulose may be swollen to a greater extent (e.g., some of the regions of

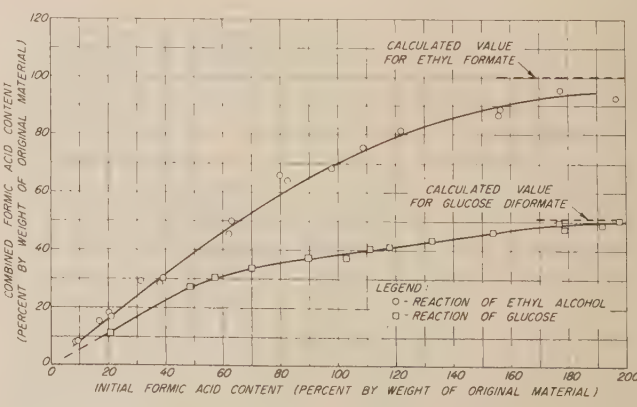

Fig. 2. Reaction curves for ethyl alcohol and glucose

higher lateral order may be swollen), yet the rate of reaction in the crystalline and noncrystalline regions may be so different that from a kinetic analysis one can determine the amount of readily accessible material.

Owing to secondary effects, the reaction may not involve the original cellulose, but a modified one. This is particularly true if chain splitting occurs. When this happens, the now shortened and mobile chains in the regions of low lateral order aline and orient themselves into regions of higher lateral order. In effect, the crystallinity is increased, and the amount of readily reactive material is reduced. The method, first introduced by Nickerson in 1941 (*15*) served as a powerful stimulus for further work and led to this concept of recrystallization of partially hydrolyzed cellulose. It hence appears more desirable to measure the accessibility of the hydroxyl groups rather than that of the glycosidic groups. One is faced here, however, with the possibility that the three anhydroglucose hydroxyls may have different reactivities. This would make analysis of the data very difficult. One should choose a reaction in which either all reacting hydroxyls have the same reactivity (Mark's deuterium exchange, Timell's reaction with sodium) or in which only one of the hydroxyls reacts (formic-acid method).

Because of the occurrence of junction points that would restrict the mobility of adjoining chain sections, the reactivity in the vicinity of the junctions may be reduced, and although such regions are not truly crystalline, their behavior to reagents may be similar to that of a crystalline region. Such small regions would be either nonaccessible or difficultly accessible. Very small but truly crystalline regions, consisting of a few repeating planes, which, therefore, may not be detected by x-rays, could also be nonaccessible or difficultly accessible. Naturally occurring cross links such as ether linkages (*12*), ester linkages or even occasional strong hydrogen bonds formed irreversibly on drying, could also reduce the reactivity without being reflected in an increased x-ray-measured crystallinity (*7*). As an extreme instance, consider the following example: It is known that the addition of as little as 1% of methylene linkages (from CH_2O) into cellulose profoundly reduces its reactivity; yet the x-ray-measured

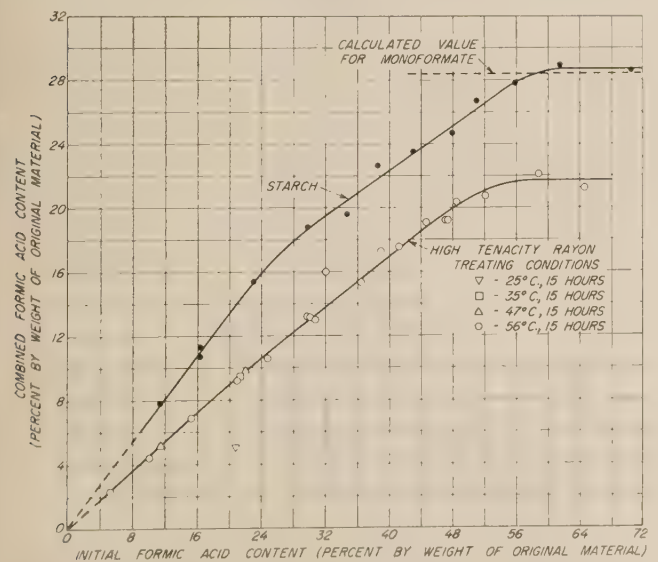
CALCULATED VALUE FOR MONOFORMATE
STARCH
HIGH TENACITY RAYON
TREATING CONDITIONS
▽ - 25°C., 15 HOURS
□ - 35°C, 15 HOURS
△ - 47°C, 15 HOURS
○ - 56°C, 15 HOURS
COMBINED FORMIC ACID CONTENT (PERCENT BY WEIGHT OF ORIGINAL MATERIAL)
INITIAL FORMIC ACID CONTENT (PERCENT BY WEIGHT OF ORIGINAL MATERIAL)

Fig. 3. Reaction curves for starch and a high-tenacity rayon

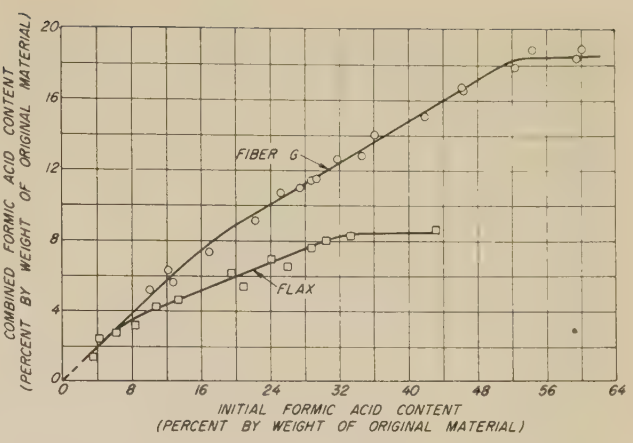
FIBER G
FLAX
COMBINED FORMIC ACID CONTENT (PERCENT BY WEIGHT OF ORIGINAL MATERIAL)
INITIAL FORMIC ACID CONTENT (PERCENT BY WEIGHT OF ORIGINAL MATERIAL)

Fig. 4. Reaction curve for fiber G and flax

crystallinity is quite likely unaffected. It has been shown that a hemicellulose given this formadehyde treatment acquires some of the properties of an alpha-cellulose. It is no longer soluble in concentrated alkali.

Mark (*4*) and Howsmon (*13*) have pointed out another difficulty in associating accessibility with x-ray-measured noncrystallinity. They point out that although the x-ray beam measures, indirectly, the amount of noncrystalline matter, during a chemical reaction in which the crystalline regions are not penetrated, the reagent reacts not only with noncrystalline material, but also with the crystalline surfaces, so that the measured accessibility may be greater than the x-ray-measured noncrystallinity. Howsmon showed how variations in the crystallite size affect the fraction of hydroxyl groups exposed on the surface. Of necessity, he had to assume well-bounded crystalline regions, e.g., micells. Actually, these regions are not well-bounded but have transition zones. How the cellulose reacts in these transition zones is, of course, unknown.

Because of the above factors, it seems desirable, if not necessary, to dissociate the word "crystallinity" from "nonaccessibility," and "noncrystallinity" or "amorphous" from "accessibility."

There are relatively few methods for measuring accessibility of the hydroxyl groups. Purves' method (*1*), based on the reaction of cellulose (as aerogel) with thallous ethylate in a series of homologous solvents, is of interest because it illustrates the effect of ease of penetration of the reactant on the degree of reaction. The values, however, seem unusually low. This may be due to (1) incomplete thallation (e.g., an equilibrium is set up in each solvent), or (2) the large molar volume of thallous ethylate. The values also seem to depend on the nature of the homologous solvents.

Mark's method of deuterium exchange (*4*) is based on the mathematical isolation of two reactions: that occurring rapidly in the readily accessible regions, and that occurring slowly in the difficultly accessible regions. Kinetic analysis yields the amount of material in each region. The accessibilities of native cellulose were found to range from 21 to 44%, while that for regenerated cellulose was approximately 66%. Recently, however, some doubt has been cast on the proposed mechanism of the reaction. Plyler (*17*) was unable to obtain infrared spectrophotometric evidence for the reduction in hydroxyl-group content as deuteration presumably occurs. More work needs to be done on this reaction.

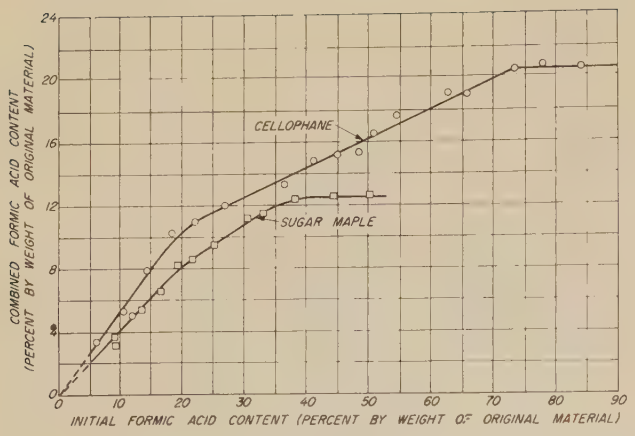
COMBINED FORMIC ACID CONTENT (PERCENT BY WEIGHT OF ORIGINAL MATERIAL)
CELLOPHANE
SUGAR MAPLE
INITIAL FORMIC ACID CONTENT (PERCENT BY WEIGHT OF ORIGINAL MATERIAL)

Fig. 5. Reaction curve for cellophane and sugar maple

Timell (*19*) studied the kinetics of the reaction between sodium and cellulose swollen in liquid ammonia (hydrogen evolution), and by a mathematical analysis similar to that of the previous one he was able to calculate accessibilities. The method is of particular interest because it is an example of a method in which the cellulose reacts while swollen to an extent much greater than it would swell in liquid water, yet the values for accessibility are similar to those obtained by deuterium exchange in which the cellulose is swollen only to the approximate water-swollen condition.

Hermans (*7*) has emphasized the importance of the noncrystalline matter toward moisture adsorption. He pointed out that as a first approximation, adsorption at a given relative humidity should increase with increasing amounts of noncrystalline matter. Thus, the simplest way of measuring the relative accessibilities of a number of celluloses is to compare their hygroscopicities at the same relative humidity. It should make no difference what humidity is chosen, since Urquhart (*20*) has shown that for a number of different celluloses, the ratio of their hygroscopicities at the same relative humidity is independent of the relative humidity, at least in the range 5 to 95%. The data of Wiegerink point to the same conclusion (*21*). Howsmon (*13*) has shown that the accessibility as measured by deuterium exchange is linearly related to the moisture adsorption at 58% relative humidity.

Another way of using moisture-adsorption data for calculating accessibilities was developed by Hailwood and Horrobin (*5*). They postulate the co-existence of unhydrated cellulose, hydrated cellulose (monohydrate of accessible anhydroglucose), and dissolved water. These three species are assumed to form an ideal solid solution. The equation for the adsorption isotherm is developed from which the accessibilities can be calculated. The values are in reasonable agreement with those obtained by previously mentioned methods (*6*). In spite of this agreement, one wonders why the thermodynamic activities of the unhydrated cellulose, hydrate, and water may be equated to their mole fractions as is done in the derivation. Considering the large difference in size between the components, one would expect large deviations from ideality.

Recently a new method has been proposed for measuring accessibilities (*18*). It is based on the ability of formic acid, under rigid conditions, to react only with the primary hydroxyl group in polyanhydroglucoses. Since the simplicity of the method is due mainly to the ease of carrying out the chemical analyses, the procedure will be described in some detail.

The reaction between formic acid and excess acetic anhydride goes to completion, at the reflux temperature, in accordance with the equation:

$$HC(=O)-OH + CH_3C(=O)-O-C(=O)-CH_3 \rightarrow 2\,CH_3C(=O)-OH + CO$$

However, if an alcohol is added to the formic acid before adding the anhydride, the volume of carbon monoxide collected is less than that equivalent to the weight of acid used. Evidently, some of the formic acid is consumed in esterifying the alcohol. It is only the unreacted formic acid that is converted to carbon monoxide by the anhydride. Thus, the volume of carbon monoxide collected when an excess of anhydride is added to the mixture of alcohol and formic acid, is a quantitative measure of the amount of unreacted acid in the mixture. If the amount of acid originally added is known, one can calculate the weight of formic acid that has reacted with the alcohol. Figure 2 shows the reaction curve for ethyl alcohol and formic acid. Abscissas are amounts of formic acid initially added to the alcohol, while the ordinates represent the corresponding amounts of formic acid combined with the alcohol at equilibrium. Note that the amount of combined formic acid increases and then approaches the value of 100, which is the calculated value for the complete esterification of the alcohol. The lower curve is the reaction curve for glucose. It is apparent that under these conditions only two of the five hydroxyls react. It should be noted (abscissas) that the liquid-to-solid ratios are very small (much smaller than in conventional esterifications), so that although anhydrous acid was used initially, after the reaction had proceeded, the water formed in the reaction was sufficient to dilute appreciably the formic acid. This may be the reason why the other hydroxyl groups do not react. By blocking off different hydroxyl groups and obtaining the corresponding reaction curves, it was concluded that only the hydroxyls in positions 4 and 6 react. Since in the formation of polyanhydroglucoses the former hydroxyl is eliminated, one would expect only the primary hydroxyl to react in these polysaccharides.

Figure 3 shows the reaction curve for a starch. The maximum combined formic-acid content is 28.7%. This agrees well with the value of 28.4% calculated for

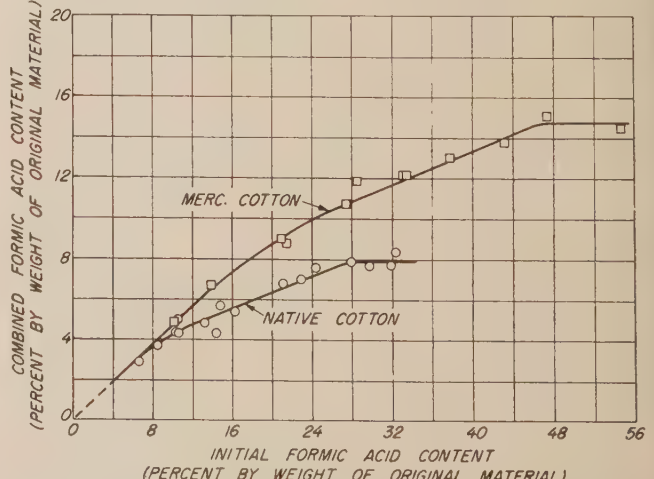
COMBINED FORMIC ACID CONTENT (PERCENT BY WEIGHT OF ORIGINAL MATERIAL)
MERC. COTTON
NATIVE COTTON
INITIAL FORMIC ACID CONTENT (PERCENT BY WEIGHT OF ORIGINAL MATERIAL)

Fig. 6. Reaction curve for native cotton and mercerized cotton

the monoformate. This fact, together with the results obtained with glucose and its derivatives, strongly suggests that in starch only the primary hydroxyl reacts with formic acid. The other curve is that for a high-tenacity rayon. Note that the maximum combined formic-acid content is less than that for a monoformate (22% instead of 28.4%). It was concluded that only a portion of the primary hydroxyl groups are accessible to formic acid, e.g., 22/28.4 × 100 or about 75%. Figures 4 to 6 show the reaction curves for other celluloses. Each one has its own characteristic maximum combined formic-acid content. This value divided by 28.4 is the fraction of all primary hydroxyls that are accessible by formic acid.

If it be assumed that for every primary group a glucose residue is made available, then these accessibilities are also the accessibilities of the glucose residues by formic acid. It is not likely that chain degradation occurs. This is suggested by the inability of formic acid to break the glycosidic bonds in alpha methyl glucoside. In the absence of chain degradation, recrystallization cannot occur.

The following tabulation lists the accessibilities of various carbohydrates:

Material	*Accessibility, %*
High-tenacity rayon	77
Cellophane	72
Fiber G	65
Mercerized cotton	52
Alpha pulp No. 1	47
Alpha pulp No. 2	35
Flax	30
Native-cotton fibers	28

Since the method depends on the reaction between formic acid and primary hydroxyl groups in pyranose residues, some doubt would arise in the interpretation of data for carbohydrates containing appreciable amounts of pentosans, polyuronides, and lignin. Such carbohydrates have been omitted from the tabulation.

These values are in reasonable agreement with those obtained by deuterium exchange. This is particularly interesting because the formic acid swells the cellulose appreciably more than does water (and presumably heavy water). From a detailed examination of the reaction curves, it was shown that the maximum number of primary groups is made available when the degree of swelling of the cellulose in formic acid is equal to that by which the original material swells in liquid water. Thus the maximum combined formic-acid content is a measure of the number of primary groups and presumably of the number of glucose residues made available in the water-swollen condition.

Figure 7 shows the relationship between these accessibilities and the moisture adsorption of the original carbohydrate. The linear relationships are a confirmation of Howsmon's observations.

It is of interest that those methods that meet certain requirements (swollen cellulose, nonchain-splitting reaction, small reactant molecule with high specific reactivity) give values that are in general accord with each other. It should be emphasized, however, that these values are not necessarily measures of the amount of x-ray-measured noncrystalline material. The cellulose is assumed to have a dual structure: a readily accessible and a difficultly accessible region. The

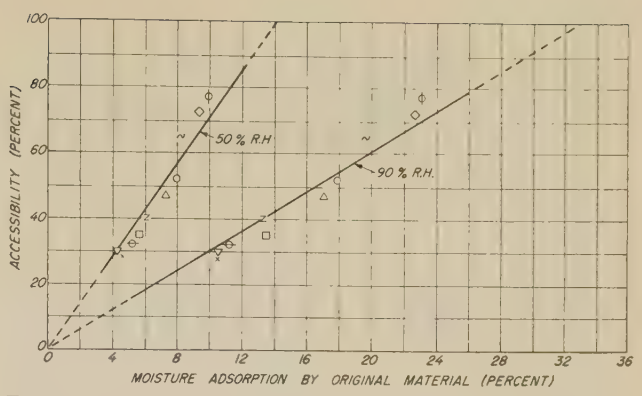

Fig. 7. Relationship between accessibility and moisture adsorption

latter, it has been seen, is composed not only of regions having at least a certain degree of lateral order, but also of those regions containing extremely small but truly crystalline regions (therefore not revealed by x-rays), cross links, and junction points that persist even when the cellulose is swollen by an amount it would swell in liquid water. The accessibility values reveal nothing about the absolute reactivity of these regions; therefore, it would be wrong to give the impression that such measurements characterize the chemical convertibility of a cellulose. The accessibility, as measured by one of the above methods, is only one of a large number of factors that may include (1) the ease of diffusing through the readily and difficultly accessible regions, (2) the presence and nature of cross links, (3) the morphology of the fiber, (4) the presence of peculiar end groups, (5) the presence of noncellulosic components, and (6) their distribution and manner of association with the cellulose.

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Measurement of Slime in a Paper Mill

L. A. McKEOWN and J. H. BARDSLEY

The surface condition of strategic sections in a mill system is an important indication of how well slime is being inhibited from growth on these surfaces. Slime measuring units using wood panels have been used for this purpose for some time. These wood panels become infected with bacteria and do not necessarily measure the slime forming ability of the white water or stock. The influence of this infection is corrected by moist heat sterilization of the wood panel. Concrete panels have been tested and may offer some advantage. The physical characteristics of the panel slime growth are more important than the weight.

DURING the last few years there has been a rapid improvement in knowledge of the problem of slime inhibition and in the successful application of bactericides and methods for control.

Early trials of bactericides were largely conducted on a hit or miss basis because of necessary ignorance of the general subject at that time. One bactericide would show a considerable improvement in slime reduction in a particular mill and would fail miserably in a neighbor mill. Probably the most disheartening feature of these applications was that there was no ready means of measuring how poorly or how successfully the trial was proceeding.

The surface condition of strategic sections in the mill system is an important indication of how well slime is being inhibited from growth. In earlier years this information could only be gathered on week ends or on system shutdowns, when these surfaces could be visually examined. The occasional effort was also made to feel headbox surfaces during operation and obtain an indication of the slime situation by the sense of touch.

One of the first men to realize that the value of this qualitative assay of slime growth could be made quantitative was Howard W. H. Jones. During 1945 and 1946 when he was at Price Brothers & Co. Riverbend mill, he tried hanging rubber panels in flowing white water, removing these at daily intervals and scraping the quantity of slime which accumulated on these pieces during this interval of immersion. He then filtered and dried the deposit and then weighed it.

The data he obtained on this original venture were difficult to interpret but despite their many variables served to confirm when there was more slime present. They therefore offered a means of appraising the condition of equipment surfaces with respect to deposits while this equipment was in operation, and could furnish daily information on the progress of slime growth.

Since 1947 this industry has really been made conscious of these slime boards by the diligent and continued efforts of Buckman Laboratories. Later they designed a flow box to house the slime board in an effort to diminish the abrasive effect of currents and eddies and other causes of difference in growth between boards due to accidental influences.

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This was an important step forward and allowed a more positive interpretation of these measurements. With their standardization on the size of boards and slime measuring units it appeared feasible to compare quantitative measurements between mills and arrive at empirical ranges which were considered safe, or those requiring increased dosage of bactericide. In other words control limits were established.

It now appeared a control problem with measurements sufficiently accurate to warrant the Shewhart graph of probability with respect to control limits and corrective action. However, after some experience with these slime measuring units it became evident that they were not a precision instrument and the measurements they provide are only a guide.

The boards on which this slime grows have come under our study. Usually these boards are of a selected section of wood and after an immersion period of several weeks are ready for use and when exposed in the mill system, will grow a slime on their surface.

This same phenomenon is noted on erection of cooling towers with virgin lumber. Their initial operation is free of slimy deposits and the wood remains clean, smooth, and bright looking. A very probable theory of explanation has been advanced that this is due to the presence of organic materials in the wood of a phenolic configuration which render the wood unfavorable to microbiological growth. With some species of wood this effect is more pronounced and may last a number of months. Eventually these bacteriostatic substances are leached from the wood or inactivated in some way and the wood surface is then neutral or receptive to microbiological fouling.

To study the action of this effect small sections of active slime growing boards were painted with solutions of various bactericides. On insertion in the slime measuring units, slime would grow in the usual manner on these boards except on those treated areas which would remain slime free. In some cases these areas would remain slime free for 3 and 4 days. They would then grow a slight film of slime and following several more days would be similar to the untreated slimy areas. Usually an active growing slime board will become discolored after use, often a dark black color. It was noted with some applications of bactericides to a board the dark black color would disappear and the painted area would revert back to the natural amber color of the wood.

Table I. Relation Between Wet Weights of Daily Sterilized Weekly Sterilized, and Unsterilized Boards

This board is 15% less . . . . . .than this board in weight . . .this per cent of the time		
Weekly sterilized board	Unsterilized board	
1st day's weight lower	than 1st day's weight	70% of the time
2nd day's weight lower	than 2nd day's weight	15% of the time
Other days weight lower	than other days	18% of the time
Daily sterilized board	Unsterilized board	
1st day's weight lower	than 1st day's weight	70% of the time
Other days weight lower	than other days	99% of the time
Daily sterilized board	Weekly sterilized board	
1st day's weight lower	than 1st day's weight	12% of the time
Other days weight lower	than other days	94% of the time

Table II. Comparison of Daily Slime Weights of Wood and Concrete Daily Sterilized Panels

(Wet weights expressed as grams per square foot)

	No. 1		No. 2		No. 3		No. 4	
	W	C	W	C	W	C	W	C
Tues.	11	9	16	14	19	21	17	20
Wed.	13	10	17	16	21	18	22	19
Thurs.	10	7	18	21	23	24	22	26
Fri.	13	10	20	17	21	24	23	19
Tues.	16	13	19	21	17	20	19	22
Wed.	18	12	21	x	21	22	19	20
Thurs.	15	x	21	20	20	21	x	x
Fri.	12	11	23	17	22	22	24	21

Since these boards grow slime and since scraping these boards to measure the accumulation does not remove all the microorganisms from the surface, it becomes evident that this board already seeded and inoculated with bacteria does not necessarily measure the slime forming ability of the white water or stock. This infection already present on the board and in the grains of the wood serves to start a new growth of slime on the board which is not a true measure of the index of slime growth of the mill system.

The opportunity to prove this occurred on several occasions. As an example, one machine system would occasionally show very much higher daily weights of slime growth than its neighbors. On exchanging slime boards the other machine would then show the higher daily weight. Changing these boards back and forth would show that the difference in quantity of slime growth was a function of this particular slime board and not of the individual machine systems.

To overcome this influence of infection from the board itself the boards were sterilized in an autoclave. This method of moist heat sterilization does not leave any residual after effect such as was found by painting the boards with bactericides. Also it has not been found to radically change the surface of the wood panel. With sterilized boards the quantity of slime growth is less than with unsterilized boards. Daily sterilization has been adopted as best suited to the conditions at this mill.

One set of these boards was sterilized at daily intervals and another set at weekly intervals. The weekly sterilized boards show a lower weight for the first day or two then become practically the same as the unsterilized boards. Table I shows the relation found between wet weights of daily sterilized, weekly sterilized, and unsterilized boards.

Since there is very little wood in the critical areas of these machines the question arose whether these wood panels were indicative of slime growth on the concrete which forms a considerable portion of the actual machine slime growing surface. Accordingly concrete panels were cast to the same dimensions as the wood panels and these were used in the slime measuring units. Measurements were made for several weeks with both types of panels, and the concrete panels were found to grow slime as well as the wood panels. The concrete panels are now used in all measuring units as it is felt there is an advantage in keeping the measurements as realistic as possible to actual mill conditions. Table II shows comparative slime weights from wood and concrete daily sterilized slime panels.

Table IV. Percentage Relation Between Panel Slime Weight and Stock Consistency

	Suction box white water, %	*Wirepit white water, %*	*Bird screen rejects, %*
Daily sterilized wood panels	100	85	52
Daily unsterilized wood panels	...	85	59
Daily sterilized concrete panels	100	96	57
Average consistency	0.07	0.28	0.81

The practice of sterilizing the concrete boards on a daily basis has not produced any ill effect to these boards so far. No particular panel is used for a certain measuring unit, and any panel is placed in any unit with reproducible results. Table III shows examples of average daily panel slime weights taken from data compiled over a 7-month period. Table IV shows the influence noted from stock consistency.

The influence of the infection from the unsterilized panels does not always provide misleading information regarding when a change in dosage is necessary. However the amount of panel infection fluctuates very widely and thus fails to provide any accuracy with respect to the magnitude of the change of mill slime activity and the extent of the control measures required. Table V shows a comparison of trends between daily sterilized and unsterilized boards.

Inasmuch as panel measurements are of value only insofar as they offer data for mill control of slime growth it is well to realize that these weights alone fail to indicate information which in our experience is of great importance. The physical characteristics of the slime growth have been noted to be indicative of the slime trouble that may be expected. Some slimes are soft and very fragile and after building up to a certain thickness, if they break loose from surfaces do not appear to cause breaks. Other slimes are very tenacious and below a certain weight do not break loose or cause trouble. The slime conditions peculiar to this mill offer more trouble when a gelatinous slime growth occurs. The control measures are then increased and more attention is paid to this type of slime growth than to the weight.

Table III. Typical Average Daily Panel Slime Weights With Range

(Wet weights expressed as grams per square foot)

Week No.	*Bird screen rejects*		*"A" Wirepit white water*		*"B" Wirepit white water*		*"C" Wirepit white water*		*Suction box white water*
	St.	*Un.*	*St.*	*Un.*	*St.*	*Un.*	*St.*	*Un.*	*St.*
					Wood Panels				
26	13 ± 3	26 ± 5	16 ± 4	32 ± 5	19 ± 4	32 ± 6	x plugged	x	24 ± 2
35	15 ± 8	30 ± 6	22 ± 8	60 ± 18	11 ± 10	37 ± 20	21 ± 4	52 ± 20	47 ± 9
41	12 ± 2	21 ± 3	18 ± 4	30 ± 4	19 ± 3	33 ± 5	22 ± 1	37 ± 3	20 ± 5
45	11 ± 1	20 ± 2	16 ± 2	25 ± 5	22 ± 2	33 ± 7	24 ± 1	38 ± 3	18 ± 3
					Concrete Panels				
46	15 ± 3		20 ± 3		21 ± 3		24 ± 2		23 ± 7
48	18 ± 2		23 ± 1		24 ± 2		27 ± 2		27 ± 2
49	12 ± 3		20 ± 3		19 ± 6		24 ± 2		23 ± 2
51	10 ± 2		20 ± 3		20 ± 3		21 ± 2		23 ± 3

Table V. Comparison of Trends Between Daily Sterilized and Unsterilized Boards

Plotting daily weights for sterilized and unsterilized boards:

1. The pattern of the graphs was similar 55% of the time.
2. There were misleading differences in pattern 11% of the time.
3. The average weight of daily sterilized boards is 51% of the average weight of daily unsterilized boards.
4. A fluctuating infection is shown because daily sterilized boards stay within the range (45 to 55%) of the weight of unsterilized boards only 32% of the time.

A quantitative method of appraising this quality of slime growth has not as yet been developed but nevertheless information for satisfactory control of this phase can be obtained by visual examination of panel grown slime.

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DISCUSSION

John W. Appling: We of Buckman Laboratories, Inc., welcome the work done by others in the application of our S-254 slime measuring unit. Although this unit has passed through the experimental stage in design, we feel that further improvements and refinements in its use will continue to be made.

The authors of the paper have presented a radically different technique for using the wood panels in our slime measuring unit and, in addition, they recommend the substitution of wood by concrete, particularly in those mill systems where concrete predominates over wood as a material of construction. In either case the panel to be used is sterilized either daily or weekly by moist heat. Although the authors did not mention the temperature for autoclaving, we shall assume that it was the one usually employed by microbiologists for sterilizing, namely 121°C. (15 p.s.i.) for 15 to 20 minutes.

First, we shall concern ourselves with the use of sterilized panels irrespective of the material employed for their construction. We do not agree that the sterilization of any type of panel has merit. All of us know that paper mill systems are not sterilized either daily or weekly even though this may be approached at infrequent intervals by a clean-up with a hot toxicant-detergent solution. Consequently, the introduction of a sterilized panel in an essentially nonsterile system for the purpose of measuring slime accretion is wholly unrealistic. In addition, the exposure of wood panels to moist heat during sterilization undoubtedly affects both the chemical and physical properties of the wood and may result in the production of toxic materials. Since the comparisons given in Table III are for wood panels, we must call attention to the potentially changed nature of the wood in the panel because of the moist heat sterilization. While concrete panels presumably would not be affected in the same way, by moist heat sterilization, the fallacy of comparing slime accretion on a sterile panel with that on nonsterile mill equipment applies in both cases.

The increasing use of slime measuring units is based, not only on the advantage of offering both visible and tangible evidence of slime accretion on a readily observable surface, but also upon the relationship between slime accretion and operating conditions. A large part of the progress in slime control during the past 5 years is the result of work which has been done on the correlation of paper machine operating conditions with the data from slime measuring units which function under mill conditions. This is in contrast to any laboratory or other indirect approach which departs from paper machine operating conditions. So far as the writer knows, the authors of the paper have not demonstrated that sterilized panels offer any closer relationship to operating conditions that can be determined by unsterilized panels.

The real value of the S-254 slime measuring unit was established when it was found that the trend of daily accretions and weekly averages provided a much higher degree of correlation with operating conditions than the methods previously employed for this purpose. We find nothing in the data presented by the authors warranting the conclusion that panel sterilization would improve the results obtained. In fact, the authors state in Table IV that the pattern of the graphs for sterilized and unsterilized panels was similar 55% of the time. The basis for concluding that the differences were misleading 11% of the time is not given nor is information given to support the conclusion that the results for the unsterilized boards were the misleading ones.

As with most measuring devices, the S-254 slime measuring unit has a range within which the measurements possess a higher accuracy. In general better correlations are obtained when the rate of slime accretion is less than 30 grams per 1000 sq. cm. per 24 hours for units which operate on furnish of headbox or cylinder vat consistency.

Based upon our experience with many S-254 units in newsprint mill systems, we would say that the data for accretion on unsterilized wood panels in Table III represent a need for better slime control. The weekly average values given in this table for unsterilized wood panels invariably exceed 20 grams and range from 20 to 60 grams per 1000 sq. cm. per 24 hours. In this connection, it must be remembered that the particular value of accreted slime per 1000 sq. cm. per 24 hours, which represents a lack of adequate slime control, must be determined by comparing accretion with operating conditions.

Like the authors, we find it difficult to date with any certainty the first determinations of slime accretion on areas of surfaces and on panels exposed in mill systems. To our knowledge, measurements of accretion both on the surfaces of mill equipment and on panels of various compositions were made as early as 1942. Some may be able to antedate this by several years; however, it seems relatively unimportant except to indicate that slime accretions have been roughly approximated for a long time.

We feel that there might be merit to the use of a concrete panel irrespective of the degree to which concrete surfaces are involved in paper machine systems. In using wood panels we have recognized that the rate of slime accretion per unit area did not necessarily agree with the average rate of accretion on the surfaces of the mill system. All that is needed for a panel surface is one which will show the same relative trend in the rate of slime accretion. If concrete panels provide this in-

formation, we see no objection to their use. Indeed we would encourage those, who desire to use them, to compare the data obtained with those from wood panels and, more important, to correlate these data with paper machine operating conditions.

It is quite generally recognized that the physical characteristics of slime accretions are of significance from the standpoint of the degree of operating difficulty which may be caused by a given weight of slime. However, evidence from a large number of mills supports the conclusion that satisfactory correlations are obtained between operating losses and the weight of accretion determined under conditions of controlled flow over the panel as provided in the S-254 slime measuring unit. In other words, variations in physical characteristics have not been important enough to overshadow the predominant weight relationship. We should also mention that there are differences of opinion about the type of slime which cause the greatest over-all losses in paper machine operation.

Two-Sidedness of Colored Paper

H. A. LIPS

Two-sidedness is one of the oldest problems facing a mill manufacturing colored paper. Colored pigments always produce two-sidedness except when run on a slow machine. The color is sucked away from the wire side of the sheet leaving the felt side more heavily colored. Most soluble dyes tend to produce two-sidedness also. These dyes generally have a greater affinity for the "fines" than they do for the long fibers. The fines behave the same as colored pigments and are concentrated on the top surface. The fines are chemically different from the long fibers and have greater surface area per unit of weight. Two-sidedness can be minimized by careful color selection. Vat dyes dyed reduced are non-two-sided. Basic dyes on unbleached pulps and on groundwood are generally non-two-sided. Two-sidedness with acid and direct dyes may be improved by control of order and time of addition to the beater and with some assistants. Two-sidedness can be minimized by tinting the wire side of the sheet. Loaded papers represent a special problem on two-sidedness and are considered beyond the scope of this paper.

Two-sidedness of colored papers is one of the most perplexing problems faced by mills engaged in the manufacture of paper. This problem has become more acute in recent years with the increase in speed of the paper machine. The speed of the paper machine is generally limited by the ability to remove water from the wet sheet and to dry it on the driers. Therefore, as the speed of the machine was increased additional ways and means were devised for removing more water from the wet sheet. More efficient suction boxes were designed, and the degree of suction was increased. The suction couch roll was developed and is today practically standard equipment on all machines. In addition, suction presses are being introduced in many mills.

These various devices, designed for removing more water from the sheet, have increased the two-sidedness. Of these suction devices, the suction couch roll is the worst offender. Two-sidedness, although much more noticeable in a colored sheet, is nevertheless, also a problem in tinted white papers and other uncolored papers. In the case of colored papers the top or felt side of the sheet is generally more heavily colored than the wire side. In most cases this is very noticeable to even the untrained observer. In the case of uncolored or white papers, two-sidedness is generally not as noticeable. The printer, when he prints paper, often notices a severe two-sidedness, the one side of the sheet taking the ink better than the other side. Careful examination of the sheet will show that the fillers are concentrated on the top surface and so are the sizing agents. Because of the uneven sizing of the top and bottom sides of the sheet many mills surface size the sheet to minimize this difference.

In considering the two-sidedness of colored papers, it seems incredible that a mass of short paper fibers can be dyed apparently uniformly, in the beater, and then by running over a paper machine produce a sheet more heavily colored on one side than on the other side. This is particularly surprising when it is realized that two-sidedness is much more acute with certain dyes than with others. Let us first consider one of the simplest forms of two-sidedness.

COLORED PIGMENTS

One dyeing property common to all colored pigments in beater dyeing of paper is that they will produce two-sidedness when run on a paper machine at any speed faster than, let us say, 150 f.p.m. The pigment has no affinity for the fiber and cannot be retained without alum or size and alum. Alum, and size and alum act as adhesives holding the pigment on the fiber. At best, this bond between the pigment and the fiber formed by the alumina, is weak and when dyed pulp is run over a paper machine the table rolls, suction boxes, suction couch rolls, etc. break this weak bond and draw the pigment away from the bottom of the sheet. Because of the matting of the paper fibers, more color is retained on the top surface or the felt side of the sheet. The pigment entrapped in the return water gradually builds up and in time causes an even greater contrast between the two sides of the paper. The top side is, therefore, much more heavily colored than the wire side.

ANILINE DYES

The cause of two-sidedness just described for pigments is relatively simple compared with two-sidedness encountered with soluble dyes. Until recently, almost all our knowledge regarding two-sidedness of soluble dyes was based on practical experience. In time it has

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been learned that certain dyes will produce a sheet having relatively good non-two-sided properties. It has also been learned that some colors are extremely poor in this respect and that they produce severe two-sidedness. This information has been gathered by careful observation of the action of a given color in a number of mills. Today most colors can be classified as to their tendency to cause two-sidedness by practical experience.

Many years ago the statement was made that two-sidedness can be minimized to the greatest extent by a careful selection of the dyes to be used. This was true at that time and is still essentially true today. In the table below are listed the two-sided dyeing characteristics of the best soluble dyes for producing a minimum of two-sidedness. Also included in the table are a few of the notoriously two-sided dyes. The vast majority of soluble dyes have been omitted from this table, but most of these dyes would fall between fair and poor.

It is interesting to note that five of the top eight colors included in this table are acid dyes and the other three are direct dyes. On May 22, 1927, TAPPI published the replies to Special Report No. 24, which dealt with the "Two-sidedness in Color of Paper." In this reply many mills specifically recommended direct dyes for minimizing two-sidedness. The reason given was that direct dyes had greater affinity for the fiber and were, therefore, not washed or sucked away from the sheet to as great an extent as acid dyes. This recommendation of direct dyes is interesting in light of our present-day knowledge which includes five acid dyes among the top eight colors.

It should be pointed out that the above observations and the dyes listed in the attached table refer to soluble dyes on unfilled bleached pulp furnishes. This includes the important grades of bleached papers where two-sidedness is important. Basic dyes are used extensively for beater dyeing groundwood and unbleached pulps. Basic dyes have a strong affinity for these types of stocks and generally are relatively non-two-sided. On bleached furnishes where basic dyes have relatively no affinity for the bleached pulp the color is more or less mechanically held on the fiber and the sheet is generally very two-sided. Basic dyes will, therefore, be eliminated from further consideration in this paper.

Table I. The Two-Sided Dyeing Properties of Important Soluble Dyes on Bleached Pulps

Excellent non-two-sided dyeing properties	
Brilliant Crocein FL Extra Concentrated	C.I. No. ... (Acid dye)
Brilliant Paper Yellow	C.I. No. 364 (Direct dye)
Ruby PL	C.I. No. ... (Acid dye)
Good non-two-sided dyeing properties	
Yellow SXG	C.I. No. ... (Direct dye)
Fast Red 8BL	C.I. No. 278 (Direct dye)
Anthraquinone Blue B, Blue BN	C.I. No. 1054 (Acid dye)
Fair non-two-sided dyeing properties	
Quinoline Yellow Concentrated	C.I. No. 801 (Acid dye)
Quinoline Yellow P Extra Concentrated	C.I. No. ... (Acid dye)
Poor non-two-sided dyeing properties	
Nigrosine WSB Concentrated Powder	C.I. No. 865 (Acid dye)
Crocein Scarlet N Extra	C.I. No. 252 (Acid dye)
Yellow CH Concentrated	C.I. No. 365 (Direct dye)
Sky Blue 6BX Concentrated	C.I. No. 518 (Direct dye)
Brown D3GN	C.I. No. 596 (Direct dye)

THE THEORY OF TWO-SIDEDNESS

Several previous investigators have noticed that in dyeing paper pulps the fines are generally more heavily colored than the long fibers. This observation has resulted in the theory that the more highly colored fines are extracted from the bottom side of the sheet by the water removing devices such as the table rolls, the suction boxes, the suction couch roll, and the suction presses. Since in this manner the fines become concentrated on the top side of the sheet this side is much more heavily colored and the sheet of paper is two-sided. This theory was investigated by Kress and Loutzenheiser, Jr., and was the basis of an excellent paper presented before TAPPI in 1942. These observers report that a study of a sheet of bond paper revealed that 18.2% of the "fines" were on the felt side and only 11.1% on the wire side of the sheet. Since this seemed to substantiate this theory these investigators undertook a study of the relative affinity of some dyes for the fiber and the fine fractions of pulp. This is still the accepted theory of two-sidedness.

To simplify this picture let us consider the fines as pigments. Since these fines become more heavily dyed than the long fibers and since they behave as pigments they are sucked away from the bottom side of the sheet and there is the same net result previously discussed under pigments with the higher concentration of fines or pigments on the top side of the sheet resulting in a deeper color.

SOLUBLE DYES ACTING AS PIGMENTS

It has already been mentioned that among the worst offenders from the point of view of two-sidedness are pigment colors. Soluble colors as a group are considerably better than pigments. However, unless some precautions are taken the soluble color will be altered so that it behaves exactly as a pigment. For instance, it is possible to take a color that produces an excellent non-two-sided sheet and by precipitating this color as a pigment cause severe two-sidedness. This is frequently accomplished inadvertently when a wet-strength resin such as a melamine or a urea formaldehyde-type resin is added to the furnish. These resins will precipitate acid and direct dyes and for all practical purposes transform the dye into a pigment. In one instance that the writer can recall a mill was running a canary bond shade with one of the Quinoline Yellow dyes. The sheet had fair to good two-sided properties. The mill then wished to run this sheet as a wet-strength sheet and added the resin at the headbox. As soon as the wet-strength resin was added the paper became very two-sided. The color was undoubtedly precipitated as a pigment and behaved as a pigment.

This same effect may be produced to a lesser degree by poor control in the furnishing of the beaters. The acid colors and many of the direct colors do not have very strong affinity for the fiber and are held on the fiber by the size and alum complex. If the color is followed immediately by the size and alum or added together with the size and alum it is very likely to partially precipitate and behave as a pigment. This will result in a greater degree of two-sidedness. The same is often true when the dye is added after the size and the alum.

In this way the dye becomes associated with the sizing ingredients before it does with the cellulose fiber, and the dye may be precipitated by the alum before it has an opportunity to dye the fiber. This results in pigmentation and more pronounced two-sidedness.

The correct order of addition cannot be over-emphasized. This is probably the most common cause of trouble in the mill when dyeing paper. The dye may be added before or after the size without too much difference. It is essential, however, to add the dye before the alum.

FIBER COMPOSITION OF THE FURNISH

The accepted theory regarding two-sidedness states that two-sidedness is due to the fact that the "fines" become more heavily dyed than the "longs" and since they are sucked away from the bottom side of the sheet and are concentrated on the top surface, the top surface is more heavily colored. Let us consider what is meant by "fines" and "long" fibers.

In a softwood such as spruce the wood is made up of fibers, also known as tracheids, which are arranged parallel with the axis of the tree. Between the fibers or tracheids is a cementing layer called the middle lamella. Chemically the tracheid is cellulose, and the cementing layer is composed of lignin, etc. This cementing layer is removed in the cooking and bleaching operation leaving the cellulose fibers. The tracheids comprise 80 to 96% of the total volume of the wood. These are the "longs," which are the fibers of softwood pulps for papermaking.

If a cross section of a spruce log is examined, the concentric rings formed by the spring and summerwood during each year of growth are clearly visible. The radial lines extending from the center of the tree or the pith to the outer surface or the bark will also be observed. These radial lines are the medullary or wood rays. The wood rays are largely made up of ray parenchyma cells. They comprise the shortest whole cells in wood pulp and are the short fibers or "fines" with which the study of two-sidedness is concerned. The function of the wood rays is to store and distribute horizontally the food material of the tree. These fibers contain a higher percentage of noncellulosic materials than the long fiber tracheids.

One large American pulp mill, at one time, deliberately sieved these "fines" from their pulps by fractionating the unbleached pulp on hillside screens. They were able to remove from 8 to 10% by weight as fines. The bulk of these fines were medullary ray fibers. As would be expected, they contained higher percentages of lignin, and considerably higher percentages of alcohol benzene solubles. The fines were very difficult to bleach and to purify. They were a dark brown color in comparison with the lighter pulp. The pulp before screening was appreciably darker than the pulp after screening. Many pulp mills making dissolving pulp improve their quality by screening out the fines before bleaching. It would not require too great a stretch of the imagination to point to the ray cells as primary causes of pitch trouble. A thorough screening of the unbleached pulp would probably greatly minimize pitch trouble and possibly eliminate it. The only reason that screening is not a common practice for papermaking pulps is that the loss in yield is too great an economic factor. A typical chemical analysis of hemlock fractionated pulp is as above.

Table II. Chemical Analysis of the Fiber Fractions

	Unfractionated	*Fractionated*	*Fines*
Hemlock—unbleached pulp			
Alpha-cellulose, %	85.0	84.3	82.3
Copper number	3.23	3.02	3.81
Viscosity	88.0	84.0	25.4
Bleached pulps			
Alpha-cellulose, %	84.6	85.4	83.0
Copper number	2.10	2.04	2.19
Viscosity	52.7	48.2	20.2
Unbleached hemlock sulphite			
Lignin, %	2.2	1.5	4.98
Alcohol benzene solubility	0.7	0.4	4.1

Short Fiber Fractions Produced Mechanically

In converting a log into paper fibers many of the long fibers are cut during the various processing steps. All of these short fractions thus produced are chemically similar to the long fibers. Nevertheless, because of the suction on the paper machine they are concentrated on the felt side of the sheet.

In general it can be stated that these fine fractions produced mechanically have greater surface area per unit weight than the long fibers. The particle size is also smaller. Both of these factors influence dyeing. It is known that the shorter the particle size of cellulose, the more reactive it becomes chemically and it would, therefore, be expected that these fractions would be more reactive in dyeing.

Dyeing Properties of Long and Short Fibers

The chemical and physical differences between the long and short fibers have been discussed. These differences account for varying degrees of attraction for the dyestuff. In general, most dyes have a greater affinity for the less pure fines than they do for the long fibers. The long fibers represent a higher purity of cellulose. In general, most dyes have less affinity for pure cellulose than they do for pulps containing small percentages of lignin and other impurities. Bleached rag pulps and high alpha pulp are more difficult to size and to dye than standard grades of bleached sulphite. This same relative degree of attraction for the small amounts of impurity present in the fines causes the fines to absorb more color than do the longs. This is a major cause of two-sidedness when running soluble dyes.

The fact that most dyes have a much greater attraction for the fines than they do for the longs can be demonstrated by dyeing a paper pulp, sizing it in the normal manner and separating the wet pulp into long and short fiber fractions. This was done in the laboratory on a Bauer-McNett fiber classifier using 20 grams of air-dry pulp. The pulp was dyed and then sized with 2% rosin size and 2½% alum. This wet pulp was then run through the fractionator in 20 minutes using 60 gallons of water.

The standard Bauer-McNett classifying procedure was modified in this work. Only two fiber fractions were separated. The first separation was on a 35-mesh screen. This screen separated the long fiber fraction. The second and final separation was made on an extremely fine 300-mesh bolting cloth. For all practical purposes this screen held all of the "fines." The fiber loss through the bolting cloth was negligible

The fractionations were carried out at a pH of 4.5 to 5.5. Permutit water at a pH of 7.0 was used. The pH was controlled between these limits by slowly adding a dilute alum solution at the fresh water inlet.

In these various runs approximately 98% of the fiber weight was removed on the 35-mesh screen leaving 2% or less fines. The fractionated fibers were then formed into a laminated sheet. A sheet was formed with approximately 3 grams of the stock retained on the 35-mesh screen. The remainder of this fraction was discarded. While the 3-gram sheet was still on the mold wire the "fine" slurry was poured on top and suction applied. In other words, the top surface of this sheet was composed of the "fine" fraction and the bottom side of the "long" fraction. This simulates the two-sidedness obtained in the mill although the differences are more pronounced in this procedure than in commercial practice. The two-sidedness is accentuated.

The apparent color depth of the fractions varied considerably from one dye to another. This indicated that dyes have a relative degree of attraction for one fraction or another. This degree of attraction could be varied by changes in the dyeing technique, but for the standard dyeing procedure of color, size, and then alum the relative degree of attraction for the fines versus the longs appears to be specific for each color and varies considerably from one color to another. In general, the relationship was the same for each color whether run on beaten or unbeaten pulp.

In studying a great many dyes in this manner, it was found that in most cases the color dyed the fines much deeper than it did the long fibers. There were a few outstanding exceptions. Among these were Crocein FL Extra Concentrated, Ruby PL Extra Concentrated, and Brilliant Paper Yellow. These three colors are probably the three best colors that are known for producing a non-two-sided sheet of bond paper. This seemed to confirm practical mill experience that had selected these colors after years of trial and error. Confirmation was also obtained on a few of the colors that were known to be notorious in their property of producing severe two-sidedness.

In the test sheets made from the pulp dyed with Crocein FL Extra Concentrated, Ruby PL, and Brilliant Paper Yellow, the fines retained on the bolting cloth were actually lighter in shade than the long-fibered fraction retained on the 35-mesh screen. In the trials made with Sky Blue 6BX concentrated and with Nigrosine WSB the "fines" were dyed much deeper than the "longs." These two colors would be expected to produce severe two-sidedness and from practical experience it is known that they do.

This relative degree of attraction in favor of one fraction of the pulp slurry for another is undoubtedly due to the chemical differences between the longs and the fines. Since two-sidedness is so specific for each individual color, the difference must be due to the relative attraction of the color for one fraction in favor of another. It has been mentioned that the fines produced mechanically might be considered more active chemically than the longs simply because of their smaller particle size. This might influence two-sidedness to a slight extent but probably would be less specific toward individual colors.

It has been frequently stated that the dyeing of paper pulp is largely a question of absorption at the fiber surface with the help of the sizing agents. Naturally the fine fractions produced mechanically in the processing of the fiber has greater surface area per unit weight than the long fiber. It is, therefore, logical to assume that if the surface of all fibers were dyed uniformly the fines would appear more heavily colored because of the larger surface area. This is undoubtedly true, but seems to be of only secondary importance in causing the two-sidedness of colored paper with soluble dyes. In dyeing unbleached pulps with basic dyes, two-sidedness is rarely a problem. In dyeing highly beaten glassine on unbleached pulps with basic dyes the two-sidedness is no more severe than in more free papers. In our laboratory investigation studies were conducted on well beaten as well as on unbeaten furnishes. The degree of beating did not appear to materially influence the relationship between the color affinity for the long and the short fiber fractions when fractionated. The inherent chemical differences between these fractions appear to be much more important than the physical differences developed during the processing. Pulps produced in different parts of the country and from different trees varied considerably in their tendency to produce two-sidedness, some pulps being much better in this respect than others.

The Dyeing Procedure

After learning how to correlate the results of the Bauer-McNett Fiber Classifier with known results based on paper mill operation the two-sided properties of many dyes were studied. Attempts were also made to improve the dyeing procedure of a given color by studying variables such as order of addition, temperature, degree of sizing, time, etc.

Order of addition was found to be extremely important. For best results the dye should always be added before the alum. Adding it before or after the size did not seem to materially affect two-sidedness. Adding the color after the size and alum invariably caused increased two-sidedness. This is particularly true of direct dyes that are precipitated by alum.

Recommended order of addition:

1. Pulp furnish.
2. Color—add as soon as beater is furnished.
3. Size—add as soon as color is mixed.
4. Alum—add 30 minutes after size.
5. Drop beater—30 minutes or more after alum.

Temperature is apparently not of major importance. Extreme cold (40°F. or less) seemed to cause somewhat more two-sidedness and a slightly warm beater seemed to improve the two-sidedness. Excessive amounts of alum appear to contribute toward more two-sidedness. The pH studies were not made in this study, but all work was done at a pH between 4.5 and 5.5.

METHODS FOR IMPROVING TWO-SIDEDNESS

Vat Dyes

Vat colors dyed reduced were among the first dyes found during this investigation which would produce a non-two-sided sheet on sulphite pulp. This class of colors seemed to dye the longs and the fines to an equal color depth judged by the sheets from the fiber fractionator. In order to check this some blue and green

bond paper was run in a paper mill on a bond machine at 550 f.p.m. For all practical purposes both the blue and the green bond shades were non-two-sided. In addition, by dyeing the vat color reduced and then oxidizing the color on the fiber, the fibers were uniformly and permanently dyed resulting in water clear backwaters with no staining of the equipment, felts, etc. The dyed paper had excellent light fastness, was completely fast to water bleeding, and was fast to acid fume fading, alkali, and chlorine ink eradicator. The dyeing cost was relatively high.

This mill run was again an excellent confirmation of the laboratory work on the Bauer-McNett Fiber Classifier.

Chemical Dyeing Assistants

In the original work with the fiber classifier it was possible to confirm mill experience with laboratory studies. This was a great help in studying two-sidedness since examinations of regular laboratory hand sheets were found of no value in studying two-sidedness. Now that a laboratory tool was available to study this phenomena a more detailed investigation could be undertaken.

The literature survey regarding the chemical differences between the long and fine fractions of the fiber furnish suggested looking for a material which would retard the exhaustion rate of the color onto the fine fraction. In studying this approach it was found that an organic dispersing agent, namely, the sodium salt of the formaldehyde condensation product of naphthalene sulphonic acid would improve two-sidedness as indicated by the Bauer-McNett Fiber Classifier. When 1% of this product was added to the pulp furnish before the color the fine fraction after screening was dyed to approximately the same degree as the long fiber fraction separated on the 35-mesh screen. In the control the fine fraction was dyed considerably deeper. It was found that the degree of color on the fines and the ratio of this color depth to the longs was directly proportional to the amount of dispersing agent used up to 1%.

This information appeared to be sufficiently conclusive to warrant mill trials. These were arranged and were successful using 1% dispersing agent added before the color on blue, green, canary, and pink sulphite bond. This mill work confirmed the laboratory conclusions based on the results of the Bauer-McNett Fiber Classifier. In the mill trials using smaller amounts of dispersing agent the two-sidedness was more severe than in the trials made with 1% based on the fiber furnish. Large amounts were found to adversely affect the sizing.

This organic dispersing agent is relatively high priced. An attempt was therefore made to find a cheaper and possibly even more effective material. A lignin sulphonic acid salt made from sulphite waste liquor proved very effective. This material when used in a concentration of 1.0% based on the fiber furnish and added to the beater before the color improved many colors. In general, it was found to be as effective as the more expensive product already mentioned.

Lignin sulphonic acid salts are manufactured by many paper mills from sulphite waste liquor. A number of commercially available types were evaluated. These types varied in efficiency and properties. Many of the commercial types were found to be highly colored and the dulling effect on the paper could not be tolerated. There are many commercial grades available as the sodium salt and others as the calcium salt. One of the grades found most effective was a type neutralized with magnesium oxide. The following properties were considered of prime importance: (1) color of solution of sample and dulling effect on the paper, (2) cost, and (3) dispersing property for improving two-sidedness.

The various grades were rated and only those meeting requirement No. 1 were tested further. The best samples were tested extensively in the laboratory and later a number of mill trials were made with the product that appeared best from a laboratory point of view.

A great many laboratory experiments were carried out testing acid and direct dyes and the influence of these "organic dispersing" agents on the two-sided dyeing properties of these colors. In most cases there was a noticeable improvement in two-sidedness. In the case of Nigrosine WSB there was no improvement apparent. In general, it can be stated that the two-sided dyeing properties of direct dyes were improved more than the acid dyes. In the case of acid dyes the improvement, nevertheless, was appreciable. As an example the direct dyeing Quinoline Yellow P Extra concentration (C. I. No. . . .) was improved to a greater extent than the true acid color, quinoline yellow concentration.

The dyeing properties of the following specific dyes were materially improved: Quinoline Yellow P Extra concentrated, Yellow CH concentrated, Yellow SX types, Stilbene Yellow G concentrated, Fast Pink BL concentrated 125%, Scarlet 4BS concentrated 150%, Fast Red 8BL concentrated 125%, Brown D3GN concentrated 150%, Orange WS concentrated 175%, Sky Blue 6BX concentrated 150%, Anthraquinone Blue BP, and Black E Double.

The two-sided dyeing properties of most other direct and acid dyes were improved to a noticeable degree.

Mill Trials

Many mill trials have been made using both the synthetic organic dispersing agent and the lignin sulphonate type. In most of the trial runs the mill run confirmed laboratory indications. The improvement generally was very noticeable. In some cases the two-sidedness was largely eliminated. Some mills have adopted the use of a dispersing agent as standard procedure on specific shades. In many cases it has overcome the two-sidedness problem on these shades and in other cases it has improved the sheet to such an extent that it continues in use.

There have been a few cases where the dispersing agent showed no improvement over the untreated control. In other trials the results have been erratic, excellent improvement having been obtained at one time and slight improvement at another time. We cannot explain these apparent contradictory results.

From the mill trials that have been run a few observations are apparent: (1) the use of a dispersing agent generally improves the two-sidedness, (2) the improvement is most noticeable with direct dyes, (3) the dispersing agent did not adversely affect other sheet properties.

The dispersing agent retards the exhaustion of the

color onto the fiber or onto the fine fraction making it possible for the color to dye the fibers more uniformly. In other words, it minimizes the special attraction of most dyes for the fine fraction of the pulp. In the presence of such a dispersing agent, the longs and the fines are dyed to a more uniform depth. To achieve this effect the dispersing agent should be added before the color and the color and size should precede the alum.

These dispersing agents will not assist in improving the two-sidedness of paper dyed with colored pigments. In fact, excessive amounts of dispersing agent may make it impossible to retain the pigment in the sheet.

Mechanical Methods

It is, of course, possible to improve two-sidedness mechanically by tinting the wire side of the sheet to equalize the shade and color depth of the two sides. This has been done by means of a roller application of color to the bottom side of the sheet in the press section. It has also been done in the size press by surface sizing the top side of the sheet with clear starch solution and the wire side of the sheet with a light-colored starch solution. In either case a careful balance is required and the surface application requires a good deal of attention. This method will accomplish its purpose, but all mills using this approach would prefer to eliminate this problem in the beater rather than resorting to this auxiliary approach.

MILL OBSERVATION ON TWO-SIDEDNESS

In an attempt to correlate the long and short fiber dyeing theory with mill practice the writer has collected samples of dyed pulp from the beater and from the "saveall" during various runs of colored paper. These pulp samples were taken to the laboratory and formed into handsheets and dried. The color depth and shade between the saveall and beater samples were then compared.

The saveall sample represents the material that is sucked away from the bottom side of the sheet during sheet formation. It is composed largely of "fines," the short fibers from the ray cells, fiber fragments produced mechanically in the processing of the pulp, color-alum floc, and fillers if used in the furnish. The beater sample consists largely of long fibers, but, of course, contains some fines, etc. These fines, however, are more concentrated in the saveall sample. The saveall sample, in other words, represents a high percentage of the material which is found on the top surface of the sheet. The bottom side contains the long fibers.

Samples collected during a run of colored paper that was very two-sided showed that the saveall sample appeared to be double the tinctorial strength of the beater sample. This sheet was dyed with Brown D3GN which laboratory studies on the fractionator also showed to be two-sided.

During another run on the same machine on a pink bond dyed with Ruby PL, the depth and shade of the two pulp fractions were almost identical. The sheet was practically non-two-sided. Similar observations have shown definitely that if the saveall and the beater samples are equivalent in shade and strength the paper will be non-two-sided. If the saveall sample is deeper the sheet will be proportionately two-sided.

Another interesting observation in the mill was made in an attempt to prove that two-sidedness is produced on the wire rather than on the driers. In former years some people claimed that two-sidedness was largely caused by the drier. The drier may influence two-sidedness if the drier is too hot, but today it has definitely been established that two-sidedness is largely produced on the wire and that if the sheet coming from the wire is two-sided the dry sheet will be two-sided. If the sheet coming from the wire is non-two-sided the dry sheet will remain non-two-sided. This was proved by collecting samples of the rough wet sheet from the doctor blade on the first press roll during a break and air drying the paper. The degree of two-sidedness in every case that the writer has examined was the same as in the finished sheet.

Loaded Papers

In heavily loaded sheets another problem of two-sidedness is encountered. The loading materials or fillers behave the same as colored pigments and tend to concentrate on the top surface or felt side of the sheet. Some colors have a greater affinity for the filler than for the fiber. These colors in heavily loaded papers will color the top surface of the sheet to a greater depth than they will the wire side. Many dyes have a greater affinity for the fiber than they do for the filler. These dyes will, therefore, produce a two-sided sheet with the wire side colored to a greater depth than the felt side. In loaded sheets it is usually desirable to use a combination.

The question of two-sidedness in loaded sheets is naturally quite involved and is influenced not only by the type of fillers being used, but also by the amount. In order to discuss this subject in greater detail it would take considerable time. It is, therefore, considered beyond the scope of this paper. It is an interesting subject for a future paper.

In conclusion, it should be remembered that, with present-day knowledge, it is possible to go a long way toward minimizing two-sidedness. The following important points should be remembered: (1) color selection, (2) time and order of addition, (3) control of suction on the suction boxes and on the suction couch roll, and (4) the use of organic dispersants.

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TAPPI Annual Meeting Tentative Program

The following is a preliminary program for the Annual Meeting of the Technical Association of the Pulp and Paper Industry to be held at the Commodore Hotel, New York City, on Feb. 19–22, 1951. A very large attendance is expected at this meeting. Room reservations should be made directly with the Commodore Hotel or hotels in the vicinity (Biltmore, Roosevelt, Tudor, Shelton, Winthrop, Lexington, Belmont Plaza, Waldorf-Astoria, Beverly or Barclay).

The papers listed below have been offered for the meeting, and will be presented if the authors are ready to do so. A final program will be published in the January issue of *Tappi*.

Tentative Arrangement of Sessions (Feb. 19–22, 1951)

Monday a.m.	Tuesday a.m.	Wednesday a.m.	Thursday a.m.
General Session	Water	Statistics	Mechanical Pulping
	Structural Fibrous Materials	Chemical Engineering	General
	Alkaline Pulping	Wet Strength Paper Machinery	General
p.m.	p.m.	p.m.	p.m.
Committee Meetings	Microscopy Corrugated Containers	Microbiological	Annual Luncheon
Vocational Education	Fundamental Research	Acid Pulping	.....
	Paper Making (Fourdrinier)	Paper Making (Cylinder)	.....

General Session

1. Secretary's Report
2. President's Address
3. Report of Tellers Committee
4. Report of Joint Text Book Committee
5. Address: "Chemical Engineering Unit Operations in the Pulp and Paper Industry," by W. L. Badger, Consulting Chemical Engineer, Ann Arbor, Mich.

Acid Pulping

1. Paper on Ammonia-Base Sulphite Pulping by Representative of Crown Zellerbach Corp., Lebanon, Ore.
2. Progress Report on the Magnesium Bisulphite Process In Operation at Longview, Wash., by C. E. Rogers, Babcock & Wilcox Co., New York, N. Y., and Svarre Hazelquist, Pulp Div., Weyerhaeuser Timber Co., Longview, Wash.

Paper Making (Fourdrinier)

Symposium on Paper Machine Slices, program to be announced.

Wet Strength

1. "The Role of the Hemicelluloses in the Mechanism of Wet Strength," by M. N. Fineman, Rohm & Haas Co., Philadelphia, Pa.
2. "Factors Influencing Retention and Efficiency of Wet Strength Resins," by Representative of American Cyanamid Co., Stamford, Conn.
3. Paper by Representative of Institute of Paper Chemistry, Appleton, Wis.
4. Panel on Practical Aspects of Wet Strength Paper Manufacture

Microscopy

1. "Routine Fiber Analysis of Pulps, Papers, and Paperboards," by N. F. Wilson, Alton Box Board Co., E. Alton, Ill.
2. "An Optical Method for Measuring Fiber Length," by Thomas Fyfe, Eastman Kodak Co., Rochester, N. Y.
3. "The Microscopy and Identification of Synthetic Fibers," by F. D. Houghton, American Viscose Co., Marcus Hook, Pa.
4. "The Microscopic Identification of Paper Fillers," by H. C. Koch, Aetna Div., Howard Paper Mills, Inc., Dayton, Ohio
5. "Some Unconventional Uses of the Microscope on Wood and Its Fibrous Products," by T. G. Rochow, American Cyanamid Co., Stamford, Conn.
6. "A Universal Scheme for Wood Identification," by B. Francis Kukachka, Forest Products Laboratory, Madison, Wis. (by title)

Fundamental Research

1. "Mechanical Behavior of Paper, Part I," by Goeffrey Broughton, and N. A. Matlin, Lowell Textile Institute, Lowell, Mass.

Corrugated Containers

Panel Session on "Manufacture, Inspection and Testing of Weatherproof Corrugated Board"

1. "New Developments in Starch Adhesives," by J. E. Killinger, Penick & Ford, Ltd., Inc., Cedar Rapids, Iowa, Moderator of Panel
2. "Starch Urea Adhesives," by E. S. Gantt, Corn Products Refining Co., Argo, Ill.
3. "PVA Adhesives," by E. G. Boyce, Grasseli Div., E. I. du Pont de Nemours & Co., Inc., Cleveland, Ohio
4. "Silicate Adhesives," by Robert Kreyling, Philadelphia Quartz Co., Philadelphia, Pa.
5. "Commercial Testing," by C. J. Suzi, Container Laboratories, Inc., New York, N. Y.
6. "Quartermaster Inspection and Tests," by Capt. R. E. Willits of the U. S. Quartermaster Corps.
7. "Production of Corrugated Board," by J. J. Koenig, Gaylord Container Corp., St. Louis, Mo.

Vocational Education

Panel Session on "The Assimilation of the College Graduate Into Industry"

Robert Ralston, General Electric Co., Pittsfield, Mass.
Gordon B. Whitlock, American Cyanamid Co., Stamford, Conn.
Dwight Durham, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
E. L. Gibson, Carbide & Carbon Chemicals Corp., Whiting, Inc.
Fred Chambers, University of Colorado, Boulder, Colo.

Chemical Engineering

1. "An Industrial Lecture Program for Students of Chemical Engineering," by Lyle C. Jenness, University of Maine, Orono, Me.
2. "Evaporator Improvements," (Tentative), by R. E. Bergstrom or G. E. Seavoy, Swenson Evaporator Co., Harvey, Ill.
3. Symposium on Digester Construction and Operation
   a. "Factors Influencing Service Life of Brick Linings in Sulphite Digesters," by Beaumont Thomas, Stebbins Engineering & Mfg. Co., Watertown, N. Y.
   b. "Corrosion Studies in Sulphate Digesters," by M. A. Scheil, A. O Smith Corp., Milwaukee, Wis.
   c. "Adding Clay to the Digesters to Prevent Corrosion," by J. C. Hair, Crossett Paper Mills, Crossett, Ark.
   d. "Progress Report on the Activities of the Digester Corrosion Committee," by H. O. Teeple, International Nickel Co., New York, N. Y.

Papermaking (Cylinder)

Symposium on Wet-End Operation of New Board Machines

1. "Air Prevention and Elimination in Vats," by Representative of Ohio Box Board Co.
2. Paper by Representative of Sutherland Paper Co.
3. Paper by Representative of Michigan Carton Co.
4. Other papers (to be announced)

Structural Fibrous Materials

Open Forum on Controversial Topics Relating to Structural Fibrous Materials

Mechanical Pulping

1. Hydrogen Peroxide Bleaching of Mechanical and Chemical Pulps," by R. L. McEwen, F. R. Sheldon, and D. H. Nelson, Buffalo Electro-Chemical Co., Inc., Buffalo, N. Y.
2. Operation of a Sodium Peroxide Bleaching Plant." by R. A. Premo, Gould Paper Co., Lyons Falls, N. Y.
3. Other papers (to be announced)

Alkaline Pulping

1. Recausticizing in the Southeast" (Including Some Practical Operating Suggestions) by Irwin W. Johnston, The Dorr Co., Atlanta, Ga.
2. Physical and Chemical Properties of High Yield Kraft Pulps," by J. McK. Limerick, Bathurst Power and Paper Co., Ltd., Bathurst, N. B.
3. Odor Elimination in a Sulphate Pulp Mill," by P. Ghisoni, G. Bozza, and P. Colombo, Vita Mayer & Co., Milano, Italy. (By title)
4. Other papers (to be announced)

Water

Symposium on White Water and Waste Treatment

1. "The Scott Paper Company Waste Disposal Plant," by David Wadleigh, Scott Paper Co., Chester, Pa., and L. G. Simons, Chas. T. Main, Inc., Boston, Mass.
2. "Integrated Rag Mill Waste Treatment Plant," by John E. Tarman, W. H. & L. D. Betz, Philadelphia, Pa.
3. "Pennsylvania Standards for Water," by J. R. Hoffert, Chief Engineer, Commonwealth of Pennsylvania, Dept. of Health, Sanitary Water Board, Harrisburg, Pa.
4. Other papers (to be announced)

Statistics

Group of papers (to be announced)

Microbiological

1. "Red Slimes," by J. R. Sanborn, National Aluminate Corp., Chicago, Ill.
2. "A New Method of Detecting Pink Slime in Paper," by J. W. Appling, Buckman Laboratories, Memphis, Tenn.
3. Other papers (to be announced)

Paper Machinery

1. "The Influence of Temperature During the Beating Process," by O. K. Ronning, E. D. Jones & Sons, Inc., Pittsfield, Mass., and C. E. Libby, College of Forestry, State University of New York, Syracuse, N. Y.
2. "Basic Performance Data on the Morden Slush-Maker Pulper," by R. Burke Morden, Morden Machines Co., Portland, Ore.
3. "The Bird-Gibbs Clarifiner," by Representative of the Bird Machine Co., E. Walpole, Mass.
4. "Apparatus for Beating Paper Pulp by Crushing Fibers Without Friction," by P. Centerick, Papeteries Belgique, Duffel, Belgium. (By title)
5. "Pulping of Waste Papers and Pulp in the Dynopulper," by G. A. Peterson, Rice Barton Corp., Worcester, Mass.
6. "The Vibrotor," by Representative of Bird Machine Co.

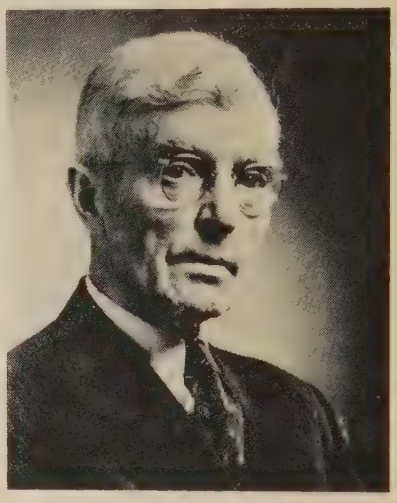
Unassigned Papers

The following papers will be assigned to appropriate sessions or may be run in a general session.

1. "Color Removal of Process Water," by J. H. Davidson, Minnesota & Ontario Paper Co., International Falls, Minn.
2. "Numerical Evaluation of Printability of Paperboard," by Clyde Eckhart, Ohio Boxboard Co., Rittman, Ohio
3. "The Bonding Strength of Certain Adhesives on Liner Board," by Geoffrey Broughton and Ernest R. Kaswell, Fabric Research Laboratories, Boston, Mass
4. "Use of Redwood Plastic Pulps in Paper-Base Laminates," by T. A. Howell's, Institute of Paper Chemistry, Appleton, Wis.
5. "Poplar Growth and Its Utilization in Paper Making in Italy," by Cartiere Burgo, Torino, Italy (By title)
6. "Paperboard Drying—Investigation by Means of an Experimental Drying Machine," by Stanley F. Smith and B. W. Atwood, St. Anne's Board Mill Co., Ltd., Bristol, England (By title)
7. "Nonchemical Digestion of Straw," by Hugh J. Stevenson, Hugh Stevenson & Sons Ltd., Summerstown Works, London, S. W. 17, England (By title)
8. "Development of a Test for Evaluating Bonding Strength of Coated Papers," by W. W. Roehr, Kimberly-Clark Corp., Neenah, Wis.
9. "Effect of Recycling Spent Liquor in Semichemical Pulping," by E. L. Keller and J. N. McGovern, Forest Products Laboratory, Madison, Wis. (By title)
10. "Factors Influencing Color Reversion in Bleached Deinked Stock," by J. J. Forsyth, International Paper Co., Niagara Falls, N. Y.

George H. Tomlinson Awarded TAPPI Medal

The nineteenth TAPPI Medal has been awarded to George H. Tomlinson, Vice-President and Director of the Howard Smith Paper Mills Ltd., and Aborite Company Ltd., of Montreal, P. Q. Mr. Tomlinson was born in Toronto, Ont., on June 19, 1880, the son of R. H. and Julia Tomlinson. He was educated at Upper Canada College and Trinity University in Toronto, graduating from the latter in 1901.



George H. Tomlinson

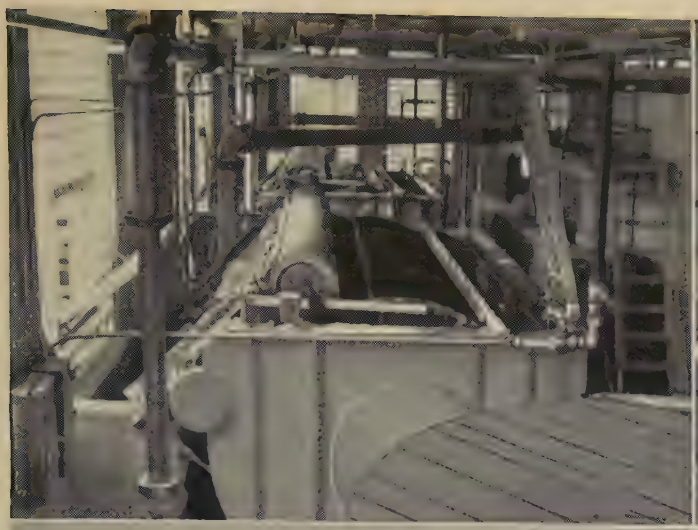
Prior to joining the Howard Smith organization, in 1924, Mr. Tomlinson was employed by the Lake Superior Power Company and the Liquid Carbonic Co. In 1909 he undertook the development of a process for making ethyl alcohol from wood waste. This led to the establishment of plants at Georgetown, S. C., and Fullerton, La. Later because of changed conditions in the lumber industry the projects were discontinued.

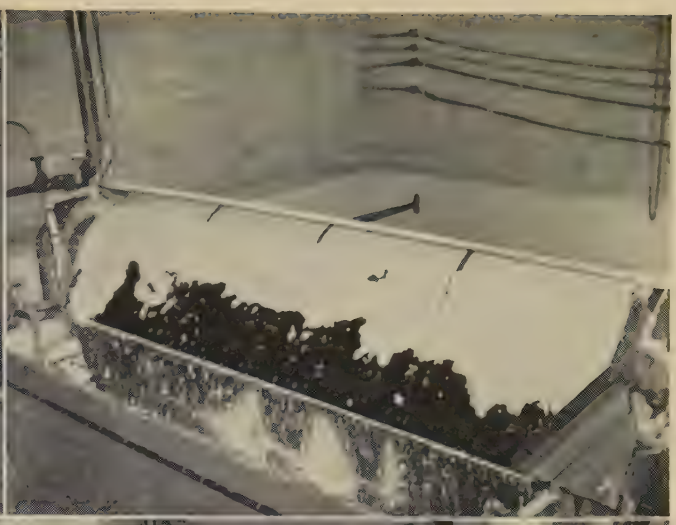
Since he has been associated with the Howard Smith Paper Mills Ltd., he has been the inventor of several commercially important patented processes. His greatest contributions to the industry have been in the field of the manufacture of chemical pulps, by applying research and sound engineering principles toward the better utilization of wood and other materials.

Mr. Tomlinson designed and was responsible for the early operation of a soda mill in Cornwall, Ont., which in 1927, operated with a combination of such now well-established process stages as continuous vacuum brown stock washing, multiple-stage evaporation, stationary recovery furnaces, and continuous causticization. He also pioneered in the continuous multiple-stage bleaching of pulp, such processing being of importance in the case of difficultly bleachable kraft pulps.

His best-known development in the alkaline processes is the B & W Tomlinson Recovery Furnace, through which a large percentage of the world's kraft liquor is now being processed.

In the sulphite pulping field Mr. Tomlinson experimented with such developments as indirect cooking with acid circulation, acid-preheating, and blow-heat and sulphur recovery.





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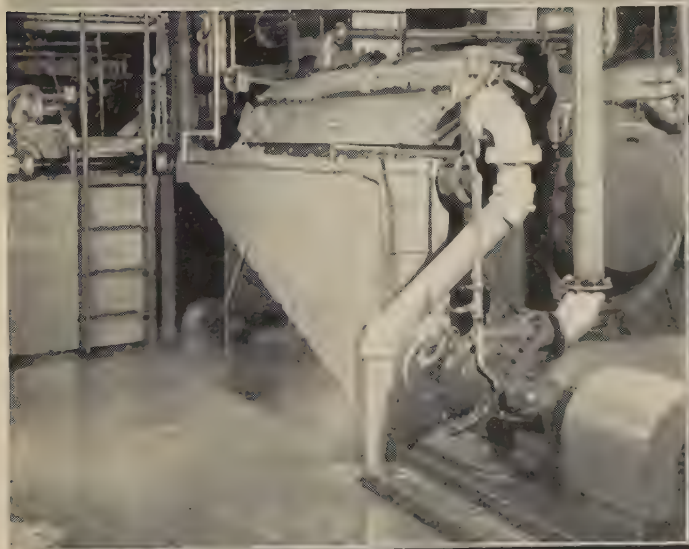

BIRD MACHINE COMPANY

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In the field of lignin research, together with a number of associates, he developed plastic materials and developed a plant to manufacture vanillin.

Realizing the difficulties inherent in the evaporation and combustion of normal calcium-base sulphite waste liquor, he experimented with other bases and found that magnesium-base waste liquor could be readily neutralized with recovered magnesium oxide, evaporated with a minimum of corrosion and without scale, and the resultant liquor incinerated to yield recoverable heat, sulphur dioxide, and a pure, chemically reactive magnesium oxide. This latter, by suspension in water, can then be continuously used for absorbing the regenerated sulphur dioxide thus obtaining fresh cooking acid and forming a cyclic process. In cooperation with the Babcock & Wilcox Co., a semicommercial scale pilot plant using the liquor from one 10-ton digester was built in Cornwall in 1936–1937. Entry of Canada into the war in 1939 delayed plans for full-scale commercial development. Arrangements were made for pooling of scientific information with the Weyerhaeuser Timber Co., who were independently carrying on parallel research, and eventually resulted in the establishment of a full-scale plant at Longview.

The TAPPI Medal will be presented to Mr. Tomlinson at the Annual Luncheon of the Technical Association of the Pulp and Paper Industry to be held at the Commodore Hotel, New York City, on Feb. 22, 1951.

C. P. P. A. Technical Section Annual Meeting

The Technical Section of the Canadian Pulp and Paper Association will meet at the Mount Royal Hotel, Montreal, P. Q., on Jan. 24–26, 1951.

Among the subjects to be discussed are kraft digester corrosion, properties of high-yield kraft pulps, mechanics of the groundwood process, fourdrinier enclosures, machine-room ventilation, process instrumentation, peroxide bleaching of sulphite pulp, heat losses in newsprint mills, operation of newsprint machine presses, and others.

Members of TAPPI will be welcome to attend this meeting.

Plant Maintenance Show

The Plant Maintenance Show will be held at Cleveland, Ohio, on Jan. 15–18, 1951. About 150 companies will exhibit. There will be a Maintenance Conference sponsored by the A.S.M.E. and the Soc. Advancement of Management. Sessions will be devoted to preventive maintenance, lubrication, and housekeeping. Advance registration should be made with Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. Housing reservations should be obtained through the Housing Bureau, Plant Maintenance Show, 511 Terminal Tower, Cleveland 13, Ohio.

New Committee Chairman

Roland A. Packard, Holyoke Machine Co., Holyoke, Mass., has succeeded Alvin H. Johnson (deceased) as Chairman of the TAPPI Mill Design and Economic Aspects Committee.

A. S. O'Brien, Eastman Kodak Co., Rochester, N. Y., has succeeded Milton Fillius as Chairman of the TAPPI Chemical Methods Committee.

Charles J. Brown, International Nickel Co., New York, N. Y., has succeeded R. T. Barnes as Secretary of the TAPPI Mill Maintenance and Materials Committee.

Robert M. Cook of the Midwest-Fulton Machine Co., Dayton, Ohio, has succeeded Harold Young as Secretary of the TAPPI Drying and Ventilating Committee.

Determination of Water in Cellulose

Both TAPPI and the American Chemical Society are conducting studies of methods for the determination of water in cellulose. They intend shortly to carry out cooperative tests on the use of the Karl Fischer method for water determination. Would any laboratories willing to take part in such cooperative testing please communicate with Dr. G. Broughton, Chairman of TAPPI Subcommittee on Moisture Determination in Pulp.

Paper-Plastics Conference

The Paper-Plastics Conference, sponsored by the Plastics Committee of TAPPI, was held in Marshall Memorial building at the New York State College of Forestry, Syracuse, N. Y., Oct. 19–20, 1950. It was attended by 272 individuals of which over 200 were from industry with representation about equally divided between the paper industry and the plastics and resin industry. The remainder, about 65, were from educational and research institutions and government agencies.

Properties of Plastics in Relation to Papermaking

Because of a railroad wreck, the Discussion Leader, Dr. Herman Mark, did not arrive until toward the close of the morning session. Dr. A. D. McLaren acted as Discussion Leader in place of Dr. Mark.

In "Adhesion Fundamentals" by D. B. Hatcher, Plaskon Division, Libby-Owens-Ford Glass Co., the basic concepts for forming an adhesive bond were reviewed and mechanical adhesion contrasted with specific adhesion. He divided types of bonds involved in specific adhesion into four classes: (1) electrostatic, (2) covalent, (3) metallic, and (4) residual bonding or diffusion forces. He emphasized the importance of the treatment of the surfaces to be bonded as an aid in developing the fullest adhesion.

The second paper, "Permeability of Polymers to Vapors," was given by A. D. McLaren, of the Polytechnic Institute of Brooklyn. Dr. McLaren discussed the relations between the transmission of vapors and the chemical and physical character of the plastic film. With respect to water-vapor transmission Dr. McLaren stated that at low relative humidities the permeability of water vapor is proportional to the product of the diffusion constant and the solubility coefficient for vinyl polymers only (below 50% relative humidity). Factors influencing water-vapor transmission and gas-vapors transmission through various types of films were discussed.

"Effect of Plasticizers on Physical Properties of High Polymers." R. F. Boyer, of the Dow Chemical Co., discussed the nature of solvent-type plasticizers, that is, external plasticization in his paper. Compatibility, efficiency, and permanence were discussed. Size and shape of the molecule influenced compatibility with polymers. The main emphasis was placed on efficiency of a plasticizer. Efficiency was described in terms of how much of a given plasticizer will lower the softening temperature or the second-order transition point. Permanence depends on the effective volatility and the rate of diffusion of the plasticizer. There is a linear relationship between the logarithm of the diffusion rate of the polymer and the brittle point of a plasticized polymer. Compatibility, efficiency, and permanence are all intimately related.

"New Polymers and Their Possible Application to Paper" by Herman Mark, Polytechnic Institute of Brooklyn was the

Left to right: A. D. McLaren, R. F. Boyer, D. B. Hatcher, R. T. Bingham, E. C. Jahn, and R. T. Nazzaro

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Left to right: Herman Mark, C. E. Libby, D. M. Yost, and W. H. Aiken

last paper on the morning program. Professor Mark indicated the potential applications of fluorinated hydrocarbon polymers and also the use of bis-phenols as a means of modifying the rigidity of phenolic resins through internal plasticization. Condensation polymers of glycol and terephthalic acid offer interesting possibilities as a new fiber. Other current developments in the polymer field were mentioned by Dr. Mark including modified polybutadienes.

Dean Joseph S. Illick gave a short address of welcome to the conferees to the New York State College of Forestry, and pointed out the development of the wood chemistry and plastics programs at the College and their relation to forestry during an informal program held at lunch.

Beater Addition Fundamentals

Professor C. E. Libby, Head of the Department of Pulp and Paper Manufacture, New York State College of Forestry, was Chairman of this session which was held Thursday afternoon. Mr. Allan Schenk of the Riegel Paper Corp. was Discussion Leader.

"The Effect of Latex Variables in Beater Addition of Nitrile Latices," by D. M. Yost, Sorg Paper Co., and William H. Aiken, The Goodyear Tire and Rubber Co., was the first of two presented on the subject of nitrile latices. The paper was given by Mr. Aiken. Mr. Aiken pointed out that a number of nitrile rubber latex variables have been studied to determine their effect on beater impregnation but that the work was limited to latices prepared with one basic polymerization system and to a medium beaten Scandinavian unbleached kraft pulp. Optimum properties were obtained with a rubber of medium acrylonitrile content and molecular weight with no additional stabilization after polymerization.

With alum as a coagulating agent optimum properties were obtained at a final pH range of 4.5 to 5.5. Somewhat better properties were obtained by coagulating with a 100-20 mixture of alum-sodium hydroxide at a final pH of 5.5 to 6.5. Coagulation with acids or acid-alum mixtures is to be avoided because it, as well as final pH values above 6.5, causes sticky sheets.

Although vulcanizing of the latex after coagulation appears to give a beneficial effect, this is offset by losses in properties brought about by the extra stabilizer that must be added along with the curing ingredients. Plasticizers improve drape and softness but decrease strength. Both stretch and edge tear are increased almost lineally with increased amount of latex while tearing strength progressively decreases. Bursting strength increased to a maximum while tensile tended to decrease.

"The Effect of Certain Papermaking Variables in Beater Addition of Nitrile Latices" by D. M. Yost, Sorg Paper Co., and William H. Aiken, The Goodyear Tire and Rubber Co., was presented next by Mr. Yost. Mr. Yost pointed out that the latex may be added to the pulp either before or after beating but that it should not be coagulated until near the end of the beating processes. The amount of latex that could be incorporated in a beaten unbleached kraft pulp was greatly increased by reducing the pulp consistency. For latex contents up to 33 parts per 100 parts of pulp better properties were obtained the higher pulp consistencies. For greater amounts of latex better properties were obtained at lower pulp consistencies. Unbeaten bleached kraft pulps showed a greater tolerance for latex than unbeaten unbleached kraft pulps. However, beating bleached pulps did not increase their latex tolerance whereas the amount of latex that could be incorporated into unbleached kraft pulps was increased by beating.

Addition of latex increased the elongation and reduced the stiffness of all pulps tested. Effect on other properties depended to a great extent on the type of pulp used. The addition of latex showed little effect on drainage properties.

The stretch and tearing strength of latex-containing sheets relative to sheets not containing latex remained the same with variation in basic weight. Edge tear, bursting strength, and tensile strength, on the other hand, showed relatively higher values at the higher basic weights.

The addition of rosin size appeared to give no difficulties in latex-pulp systems. The addition of clay, however, reduced physical properties. It would appear that pulps may be dyed but that best results are obtained when the color is added after the latex but before the alum.

The wet broke can be easily reworked with no appreciable reduction of properties. The dry broke on the other hand is hard to disperse and gives reduced properties. Mr. Yost pointed out that a mill run has been made with the latex developed in these studies and that results obtained were in excellent correlation with the laboratory studies.

The third paper was "Phenolic Resins in Paper Modified by Acrylonitrile Rubbers" by R. C. Bascom, B. F. Goodrich Chemical Co. Mr. Bascom pointed out that phenolic resins are being used in nitrile rubbers as reinforcing resins to increase toughness and abrasion resistance and are used for such widely divergent applications as bonding automobile brake shoes to linings and bonding shoe soles to shoes. The introduction of nitrile rubber in conventional phenolic molding compositions causes pronounced changes in physical properties. Nitrile rubber phenolics withstand shock loads of from $1^1/_2$ to 8 times greater than phenolics alone before first signs of failure and withstand shock loads of from 2 to 15 times greater than straight phenolics before complete failure. Mr. Bascom pointed out that the problem is to develop means of taking advantage of these desirous properties using methods and equipment available to the paper industry. He described laboratory experiments following techniques described by Snyder and his co-workers (April, 1950, *Tappi*). Pulp stock in the beater is added to an alkaline pH and the modified resin thoroughly dispersed with the roll lifted. The diluted phenolic resin is then run in at a point where maximum agitation is present. After a suitable dispersion time, the precipitating agent is added which will reduce the furnish to a point of 4.0 to 4.5. Incorporation of nitrile rubber results in improved flow and increased impact strength. This property is particularly important in the production of laminates in that such laminates may be cold punched without fracture. When high impact compounds are used the resin and rubber may be co-precipitated followed by dewatering, extruding, and conditioning. When laminating papers saturated off the machine are molded, the resin flows away from the fibers

Left to right: I. J. Gruntfest, V. J. Mosher, and R. C. Bascom

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Left to right: H. M. Spurlin, F. A. Simmonds, R. H. MacClaren, and Harold Tarkow

resulting in a dense structure, and there is no evidence of flow of fibers or rupturing of the sheet.

"Applied Studies of Cationic Urea Formaldehyde Wet-Strength Resins," by I. J. Gruntfest, E. M. Young, Jr., and V. J. Mosher, Rohm and Haas Co., was presented by I. J. Gruntfest. Mr. Gruntfest pointed out that cationic urea formaldehyde wet-strength resins are now widely used in the paper industry. The known theory of the action of these resins, however, does not permit prediction of the time that the resin must be in contact with the stock in order to obtain optimum results. In the studies, described by Mr. Gruntfest, a typical unbleached southern kraft furnish was used, and it was found that even under the most severe stock dilutions and short contact times that there was no interference with the satisfactory performance of these cationic resins. The sulphate ion which has been found to reduce the effectiveness of the cationic melamine formadehyde resins has no deleterious effect on the results obtained with the cationic urea resins.

Cellulose—Accessibility, Reactivity, and Properties Relating to Plastics

Forrest A. Simmonds of the U. S. Forest Products Laboratory was Chairman of this session. Dr. John A. Howsman of the American Viscose Corp. was Discussion Leader.

"Pulp Property Requirements for Dissolving Pulps" was given by Robert H. MacClaren of the Eastman Kodak Co. Dr. MacClaren pointed out that the use of wood pulps in the nitration and viscose processes involves little difficulty but that in acetylation there are several problems most of which resolve around the lack of clarity in the solution and the film. An example of the difficulties involved is illustrated by the use of distilled water. If distilled water is used to wash the pulp, one will end up with a muddy acetate film. It is necessary to have calcium ions present to neutralize carboxyl groups. Even a very small amount of carboxyl is of consequence. Dr. MacClaren pointed out that it is difficult to evaluate pulp for acetylation except by actually acetylating.

"Kinetics and Equilibria in Cellulose Reactions," H. M. Spurlin of the Hercules Powder Co. pointed out that such terms as accessibility, crystallinity, and so forth, must be defined in terms of the methods of measurement, and he compared data obtained by different methods. He discussed at some length the heterogeneity of cellulose dwelling particularly upon Timell's work.

A discussion of accessibility must be defined in the terms with which one is working such as acetylation, moisture adsorption, xanthation, and so forth. The same measurements cannot be used in all cases for different processes.

"The Accessibility of Cellulose," by Harold Tarkow, U. S. Forest Products Laboratory, was the third paper of the Friday morning session. Dr. Tarkow discussed various methods for arriving at a value of accessibility and described in detail the work of the Forest Products Laboratory on the new method based on the ability of formic acid to react only with the primary hydroxyl group in the anhydroglucose residue. A relatively noncrystalline material like starch forms only a monoformate. Different celluloses acquire formyl contents less than that for a monoformate with the values decreasing appreciably between that for rayons and that for native cellulose. The ratio of the formyl content to that for a monoformate is assumed to be the fraction of readily accessible material. The values obtained are in agreement with those arrived at by the other nondestructive chemical methods.

Unfortunately, Dr. Nickerson's train was delayed by more than 4 hours, and he did not arrive in time to present his paper at the morning session. Therefore, the paper, "Accessibility as Determined by Formic Acid Esterification," by R. F. Nickerson, Monsanto Chemical Co., was given the first thing after luncheon. By formulation of starch and other amorphous polysaccharides, Dr. Nickerson pointed out that one can arrive at a figure for theoretically complete accessibility. Then by carrying out a formulation of cotton, wood pulp, and so forth, it is possible to get a value which may be expressed as a per cent of the formulation of a completely accessible material and that this can then be considered an accessibility value. Dr. Nickerson pointed out that time is an important factor and that even with a crystalline material slow breakage of crystalline bonds takes place so that there is a continued slow increase in formyl content. Therefore, it is important to take time into consideration, and this he did by extrapolating his values back to zero time. In this way Dr. Nickerson believes it is possible to arrive at a fairly accurate value for true accessibility.

There was no formal program at Friday's luncheon but Mr. Wheadon, Director of the Institute of Industrial Research of Syracuse University, and Dr. Hardy L. Shirley, Assistant Dean of the New York State College of Forestry, spoke very briefly. Mr. Wheadon told in a very few words the main objectives of the Institute of Industrial Research, and Dr. Shirley gave a brief résumé of the graduate research program of the College of Forestry.

Plastic Coating Fundamentals

Dr. R. T. Nazzaro who teaches the course in plastics technology at the New York State College of Forestry served as Chairman of this session, and Dr. R. H. Kienle of the American Cyanamid Co. was Discussion Leader.

"Alathon Polythene Coatings—Properties and Techniques" by Alfred Stockfleth, E. I. du Pont de Nemours & Co., discussed the use of polyethylene for paper coatings from the point of view of its inert properties and its resistance to moisture-vapor transmission. He contrasted these properties in film formation and in hot melt applications. The resistance to moisture-vapor transmission for the most part is the most important use property. Mr. Stockfleth also brought out the stress-strain changes with temperature and showed that the polyethylenes were quite dimensionally stable. Polyethylene is useful at a wide range of temperatures which makes it particularly important in frozen food packaging. In the discussion following the paper Mr. Stockfleth pointed out that it is possible to look forward to the application of polyethylene to paper by means of organosol and aquasol coatings which, of course, are more directly usable by the paper industry.

Mr. Wendt presented the paper, "The Effect of Compounding Variables on Styrene-Butadiene Latex Used for Protective Coatings for Paper" by M. E. Wendt and William H. Aiken, The Goodyear Tire and Rubber Co., and pointed out that

Left to right: E. A. Haddad, M. E. Wendt, R. F. Nickerson, A. L. Hatfield, and W. A. Schenck

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such a study was made of the use of a coating composition of a butadiene-styrene co-polymer latex, an emulsified wax, and a thickening agent. Emphasis was placed on obtaining a coated paper with good grease resistance and a low water-vapor transfer rate. Best results were obtained in combination with high melting point microcrystalline waxes. At least 30 parts of wax per 100 parts of latex solids were necessary to give low water-vapor transfer rates. The use of a thickening agent improves resistance to passage of water vapor and also reduces the tendency toward foaming. The coating must be heated to a temperature of almost 180°F. to produce a continuous film of coating on the paper. Maximum properties were obtained by fusion at 300°F. In the laboratory with a 30-pound supercalendered kraft paper a water-vapor transfer rate of 1 gram per 100 square inches for 24 hours was obtained with approximately 15 parts per ream of coating. The sheet also had excellent grease resistance. Mr. Wendt pointed out that the same results have been obtained with production equipment at half this coating weight and that these properties were not appreciably affected by creasing the sheet.

"The Technology of Styrene Latex Paper Coating" was given by Eli A. Haddad of the Monsanto Chemical Co. Mr. Haddad reviewed the technology of styrene latices and their application to paper giving details with respect to one type of "lustrex" latex. He pointed out that the formulation of "lustrex" latex paper coating is still in the initial stages of development. One of the main factors apart from plasticizer incorporation in the use of thickening agents and modifiers. Of particular interest is the use of an alkali-soluble styrene co-polymer which reacts ammonia or alkali metal hydroxides to form water-soluble salts. Mr. Haddad pointed out that the so-called short medium and long formulation differ mainly in the concentration of plasticizer to resin. The difference in composition obviously yields products of varying degrees of flexibility.

The last paper "The Versatile Vinyl Enters the Paper Coating Field" by A. L. Hatfield, B. F. Goodrich Chemical Co., described procedures for the formulation and application of vinyl chloride and vinyl chloride co-polymer resins as plastisols, modified plastisols, solutions, and latices. He placed particular emphasis on latices inasmuch as vinyls in this form can be handled by either an on- or off-machine paper-coating process. This flexibility of application makes it possible for the paper producer to coat his own board in the manufacture of grease and moistureproof paper products. Mr. Hatfield cited other applications for both functional and highly decorative vinyl coatings.

The paper by H. Tarkow appears in this issue of *Tappi*. The others will be published later.

The Technical Association is deeply appreciative of the efforts of E. C. Jalm, Chairman, and R. T. Nazzaro, Secretary of the Plastics Committee, who together with the discussion leaders and speakers, were responsible for the success of this conference. Acknowledgment is also made to the New York State College of Forestry for all their courtesies in providing the facilities for the meeting.

Alkaline Pulping Conference

The Fourth Alkaline Pulping Conference to be sponsored by the Technical Association of the Pulp and Paper Industry was held at the George Washington Hotel, Jacksonville, Fla., Oct. 25–27, 1950. Previous meetings of this group were held in Savannah, Ga., New Orleans, La., and Ashville, S. C. Over 200 representatives of the pulp and paper and allied industries participated in the program which was organized by Henry Vranian, Chesapeake Corp., West Point, Va., Chairman of the TAPPI Alkaline Pulping Committee, and Robert R. Fuller of the Gulf States Paper Co. in Tuscaloosa, Ala.

Causticization

Mr. Fuller opened the program with a review of the perti-

Front (left to right): W. F. Gilespie, K. G. Chesley, R. R. Fuller, C. E. Hartford, H. Vranian, and M. L. Oliver
Rear (left to right): F. L. Jones, P. Gilmont, M. B. Pineo, W. P. Lawrence, E. A. Harper, G. C. Kimble, K. M. Guest, and R. G. Macdonald

nent points indicated in previous literature which he mentioned as being lacking in continuity. Efforts should be made to round out the data so that they would be more useful. However, general agreement was found in the relationship of sulphidity and causticity which calls for a balancing and then maintaining these factors.

"The Effect of Per Cent Causticity on the Settling Rate of White Liquor" by Milton R. Roberts and E. A. Harper of the Hudson Pulp and Paper Co., the next paper, was presented by Mr. Roberts in which they reported on several causticizing tests that were made using the regular mill supply of lime to the caustic system. The settling rate was noted in each case and the degree of variation was noted in the per cent causticity. The variation was over a range of typical mill operation in order for the tests to show practical information. It was found that as the per cent causticity increased the settling rate was decreased. During the above observations the total alkalinity content remained practically constant. In order to have a more complete picture of the effects of variables on the settling rate of white liquor, a series of tests was conducted in which the total alkalinity was varied and the per cent caust'city was adjusted to remain constant. In this case the concentration of the total alkali did not show a marked affect on the settling rate. Therefore, it was the conclusion of the observers that: (1) the per cent causticity does affect the settling rate of white liquor and (2) the total alkalinity does not noticeably affect the settling rate.

This discussion was followed by L. B. Taylor, of the Pittsburgh Plate Glass Co., Columbia Chemical Division and Southern Alkali Corp., who presented "Hydrogen Sulphide and It's Application in Sulphidity Control." A process was described for generating hydrogen sulphide from sulphur and lime. The gas can then be absorbed in the white liquor to adjust the sulphidity upward. The byproduct thiosulphate formed may be added to the white liquor or added to the black liquor going to the furnace. The byproduct calcium monosulphite may be reacted with the soda ash in the green liquor to form sodium monosulphite which can be added to the white liquor.

The last formal paper of the morning was "Causticizing Equipment" by J. M. Kahn, Infilco, Inc. The experimental work on this new process was first reported at the Annual Meeting of TAPPI in 1946 and further reports which involved pilot plant work at the Nekoosa Edwards Paper Co. were contained in a company bulletin. Briefly, the process is based on the coagulation of impurities in green liquor through the addition of magnesium sulphate, and the centrifugal separation of the sludge. The clarification process is accelerated, and the physical and chemical properties of both mud and liquor are improved.

The panel to discuss causticizing included R. R. Fuller, J. M. Kahn, W. B. Gery of the Dorr Co., F. L. Jones, St. Joe Paper Co., W. M. Ebersole, Macon Kraft Corp., H. O. Teeple, International Nickel Co., Harold Morris, National Container Corp., and L. B. Taylor. Mr. Gery advocated the use of an extra slaking step as provided in the Dorr system. The hot lime from the kiln goes to the primary slaker and the make-up lime to the secondary unit. This procedure eliminates hot

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Henry Vranian and R. R. Fuller

lime storage. Mr. Teeple indicated that corrosion problems in causticizing equipment were not too serious and that only occasionally were circumstances such as to require corrosion resistant metal. In such cases monel is to be preferred, especially if hydrochloric acid is used for cleaning purposes. Mr. Ebersole made suggestions as to the control of both the kiln and causticizing stages based upon the Macon Kraft Corp. operations. Harold Morris reported on the results of two cooks which differred in amounts of total solids. It was found that the clearer liquor gave lower yields and permanganate number and a stronger pulp which would indicate possibilities for a decreased consumption of white liquor. Mr. Jones emphasized the need for standardized reporting of test results. He outlined the control procedures used in the causticizing operation and remarked that the laboratory reported results in grams per liter while the mill used pounds per cubic foot or gallon which often can be confusing.

Lime Burning

Wednesday afternoon was devoted to kiln operation with Henry Vranian, chairman. The first paper was presented by S. A. Kiedl of the Allis-Chalmers Mfg. Co., on "Lime Recovery Equipment." A brief description of the kiln and its maintenance was given. Mr. Kiedl then outlined the principles of operation and mentioned that many kilns are run on the basis of the operator's judgment without provisions for automatic loading or control of the composition of the feed. Conditions are sometimes aggravated by lack of adequate storage facilities so that instead of balanced operation of the kiln, it is run dependent on the requirements of the causticizing equipment.

The next paper "Selecting the Kiln for Paper Mill Operation" was given by B. Magee of the Traylor Engineering and Manufacturing Co., and was based on notes compiled by Ralph E. Gibbs, Consulting Engineer, York, Pa. Mr. Gibbs passed away suddenly before he could complete a formal paper. The discussion contained the thermodynamic factors involved in kiln selection and then developed a practical example, based upon the foregoing data. It was stressed that selection of the proper size of kiln should be determined not only by the capacity desired but also by the economics of operation.

"The Operation of a Bird Centrifuge as a Lime Mud Filter" by Frank L. Brinkley, North Carolina Pulp Co., was given next. This paper described the use of a Bird centrifuge as a feed to a new kiln installed at their plant. The slurry is pumped from a white liquor settler, then to a single-stage mud washer, a storage tank, and then to the feed box of the centrifuge. This unit has a small drum, to which a steel plate in the form of a spiral is affixed, located inside of a layer drum. The slurry is fed between the drums and the liquid removed by centrifugal action. The two drums operate at slightly different speeds so that the spirally formed plates act as a screw and convey the solids to the top of the unit where they are discharged to the kiln. It has been found that the action of the centrifuge has not been seriously affected by variations in the slurry, and that the sludge is delivered to the kiln at a higher solids content than that obtained with a vacuum filter.

The last paper "Operation of Sludge Recovery Kilns" by R. S. Walker, Traylor Engineering Co., was summarized during the panel discussion on kilns which followed. There are kilns of all sizes being operated by the pulp mills in the country, and the size of new installations should be determined only after careful study of all the production and economic factors involved. The manufacture of lime is dependent on time and temperature; in short kilns, the lime is calcined at a high temperature for a shorter period of time, and in long kilns, the calcining zone is lengthened and the temperature reduced. The longer calcining zone produces a softer burned lime and gives a calcium oxide which is more readily and quickly available to the causticizing operation. The control of the kiln involves the rate of feed, speed, flame and calcining zone, and the draft and temperature. These must be balanced. Instrumentation is very important as regards draft control, flame control, and stabilization of temperature. The use of thermocouples rather than optical pyrometers was particularly recommended.

The kiln operation panel also included A. E. Reed, Gaylord Container Corp., J. E. Bramlett, Champion Paper & Fibre Co., T. C. Johnson, Union Bag & Paper Corp., with Mr. Brinkley as Panel Leader, Mr. Walker, and Mr. Kiedl.

Mr. Reed discussed the formation and elimination of rings in the kilns. There are three types: mud rings at the feed end, rings in the center where the temperature is in the 1500 to 1600°F. range, and rings at the firing end. Changing the type of feed eliminated the rings at the feed end, but there was especial difficulty with those that formed in the center section of the kiln. It was found that sodium compounds were chiefly responsible and changing of their causticizing system which decreased the alkalinity eliminated the trouble.

Mr. Bramlett stated that they have found that if the sodium oxide content is maintained at about 0.5% (based on dry sludge) they have little difficulty with ring formation and that the kiln lining has a longer life. Proper control of the dust from the kiln stacks is a necessity from the economic standpoint and also because of the unsightliness of the surroundings and effect on electrical insulation caused by the dust settling from the stack.

General Session

Thursday morning, October 26, was devoted to general

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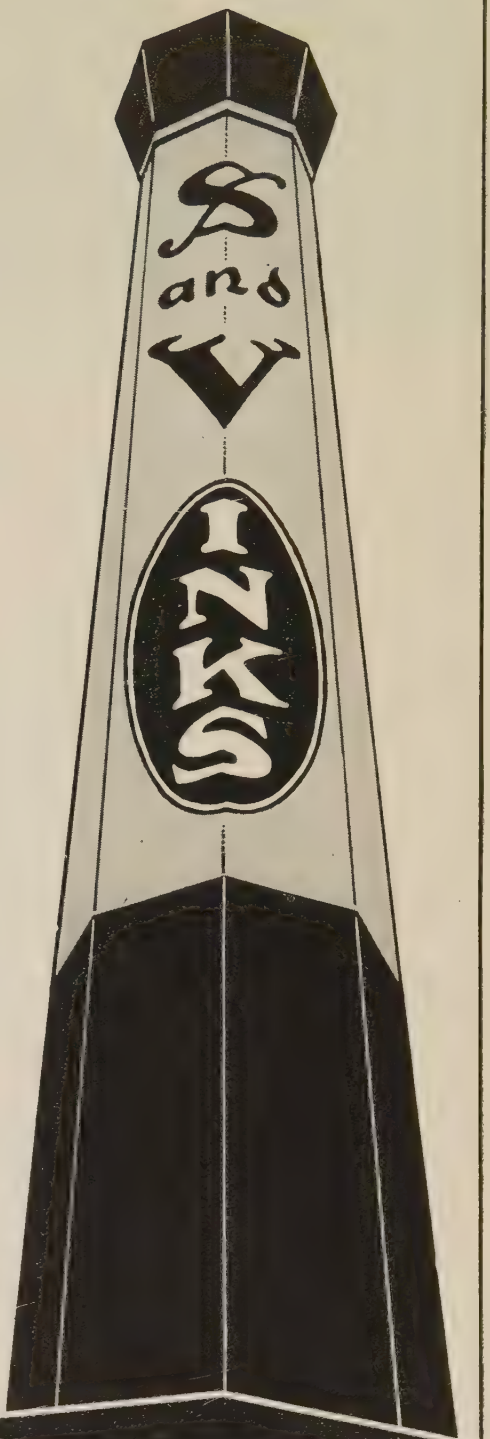

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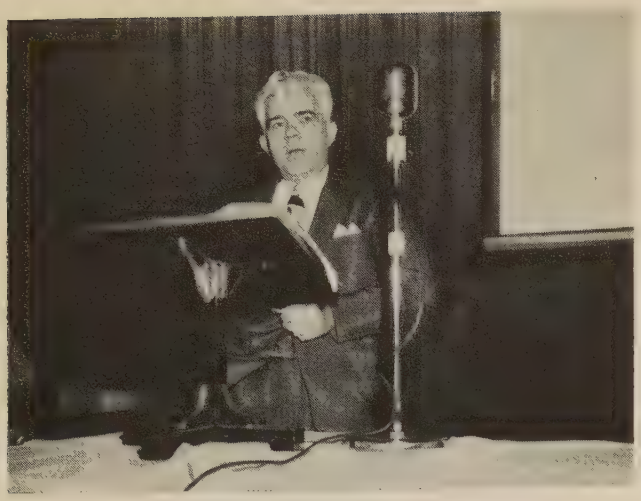


W. F. Gillespie discussing effect of wood storage on yield

papers on various phases of the alkaline pulping industry, with R. R. Fuller of the Gulf States Paper Co., acting as chairman.

The first paper in the morning was "Pressure Washing of Kraft Brown Stock" by Erik Zimmerman and Henry Vranian of The Chesapeake Corp. of Virginia. A description was given of the newly developed three-stage continuous pressure washing system which has proved successful on board stock at a kraft pulp mill where two 300 air-dry lines are in operation. The equipment is quite different from any other system, resulting in safe operation with considerable economy in water, heat and space. Plugging difficulties have been successfully solved, and foam difficulties caused by air entrainment are eliminated because the system is maintained at pressure.

In the presses the pulp is subjected to high pressures forcing liquor from the uncooked particles and is discharged at 37% moisture-free consistency. Several pressings are made according to the number of stages desired, and between pressings the stock is repulped with countercurrent liquor. Consequently, excellent separation is obtained between stages. Because of the intense pressure and rubbing action in black liquor at 200°F. temperature, there is indication of some fiber strength development.

The total water consumption for the 300-ton system is 180 g.p.m. with temperatures exceeding 200°F. The high wash water temperatures allow more efficient blow heat recovery and sends hotter liquor to the evaporators. On account of high consistencies the filtrate volumes are small so that large pipe lines and large pumps are not used. This factor is responsible for considerable power saving.

The total power consumption for a three-stage 300-ton system is 1.36 hp.-days per air-dry ton. Because the equipment comes in compact integral units, there are many possible variations and arrangements which can permit an economical use of space.

Some operational and economic problems posed by wood storage in the South were discussed by H. L. Keaton and W. F. Gillespie in their paper "Effect of Storage of Southern Pine on Pulp Yield and Quality." Operational difficulties presented by wood storage are as follows: difficulties in handling easily removed bark, jamming conveyors, sprockets, and chains, excessive chipper fines, low yields, low tests, and changed black liquor characteristics. A comparison of dry-inventory wood which showed marked signs of decay was made with freshly cut green southern pine to determine the effects of prolonged storage on chipping and pulping characteristics and pulp quality. A 4-day mill run of 100% five months old, relatively dry, inventory wood was made following the experimental cooks.

On the basis of laboratory experiments and verified in part by mill runs, pine wood held in inventory till affected by partial decay will differ from freshly cut pine in the following manner: (1) produce about 4% more fines under 1/4 inch size during chipping, (2) approximately 20% less moisture-free wood can be packed in a given volume, (3) has a lower specific gravity, (4) pulp yields are decreased by about 3.3% screened pulp in intermediate pulp hardness ranges, based on moisture-free wood.

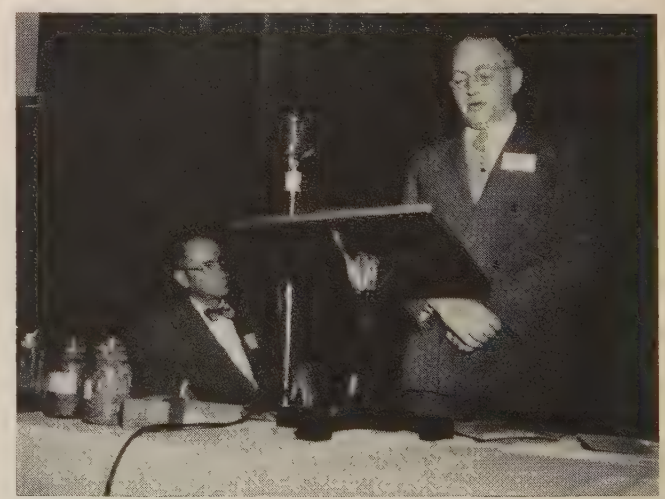
Compared at the same apparent densities (0.65 grams per cc.) pulps produced from dry inventory wood when compared with comparable hardness pulps from green pine show: (5) (a) approximately 15% lower burst factor, (b) approximately 25% lower tear factor, (c) approximately 12% lower normal tensile strength, (6) pulp from freshly cut pine develops a greater specific surface on beating, (7) handsheets from dry inventory pine wood pulp are denser than those from freshly cut pine wood pulp.

"Studies in Continuous Alkaline Pulping" by L. M. Reeder of The Ethyl Corp., and R. L. Harvin, C. W. Rothrock, and W. J. Nolan of the University of Florida, was the next paper on the program. The results of preliminary research on the problem of continuous cooking of alkaline pulps were presented. The pulping characteristics of slash pine and scrub oak were investigated. The work has been developed in three phases. In the first phase, scrub oak chips were pulped at constant temperature using normal liquor-wood ratios which allowed the concentration to drop rapidly during the cook. In the second phase, scrub oak chips were pulped under conditions such that temperature and concentration were held substantially constant throughout the cook. In the third phase of the work both oak and pine were pulped under constant conditions, with the chips being softened and shredded in a hammer mill before pulping.

Constant temperature, other cooking conditions being held normal, increased the speed of the pulping reactions but not sufficiently to warrant the use of a continuous process. When pulping under conditions of constant temperature and concentration the speed of reaction increased to the point where pulps were produced in 15 to 30 minutes. Yields were low (35 to 40%) and screenings were excessively high (20 to 30%). When chips were shredded before pulping under constant temperature and concentration conditions, pulps of good yield and low screenings were produced in 15 minutes cooking time. These conditions appear well suited to continuous pulping.

Physical strength data for pine and oak pulps produced in 15 minutes were presented. The results indicate that the shredding operation prior to pulping does not damage the fibers appreciably.

Pulps may be produced continuously from both slash pine and scrub oak. The best conditions found thus far for pine are: 50 grams per liter concentration (expressed as Na_2O),



W. O. Hisey speaking at the Waste Disposal Session

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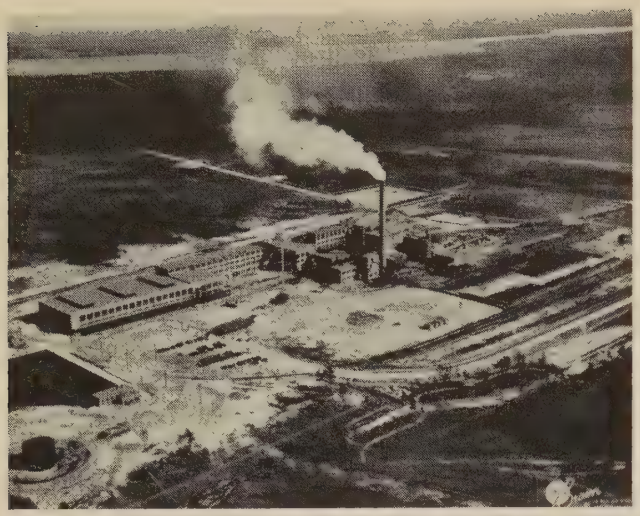

Hudson Pulp & Paper Co. mill at Palatka, Fla.

25% sulphidity, steam pressure 148 p.s.i.g. (360°F.), cooking time 15 minutes. The best conditions for oak were the same as for pine except that the cooking liquor contained 35 grams per liter instead of 50 grams per liter.

The results of the preliminary research presented in this paper indicate that continuous pulping should be practical. Work is in progress to further substantiate the evidence thus far developed.

Kenneth W. Coons, National Southern Products Corp., and R. R. Fuller, and McDewain Sandlin of the Gulf States Paper Corp., were the authors of the paper "Direct Contact Condensers." This paper reported on the equipment, technique, and results of an investigation into the requirements for the design of direct condensers, in which contact is made between a vapor (which may or may not contain a gas) and the condensing fluid. Such equipment may be used to recover vapor of the same composition as the quenching fluid, or the condensate may be another compound and may be soluble or insoluble in the quenching fluid. The advantages of such equipment are those associated with its freedom from fouling, the possibilities of corrosionproof construction, the small space required, and the weight savings that are possible.

The paper described a rotating disk condenser originated for this work, which makes possible the obtaining of data under controlled conditions hitherto unattempted. The variables controlled included surface area, non-condensables in the vapor, condenser volume, composition of the vapor and of the quenching liquid. A study was also made of the condensation of the vent gases from the digesters of the kraft pulp process. Based on these studies a direct condenser system was built and tested for handling the vent gas and recovering the turpentine from a 350-ton kraft mill.

"Compensating for Chip Moisture Variations by Chip Weighing" by Murry L. Oliver, Continental Can Co., reported on an investigation involving the weighing of pine chips at the digesters in the sulphate cooking process. Moisture tests were made on 190 experimental cooks in the 3000 cubic foot mill digesters. The weighing device substantiated the fact that with increasing chip moisture the chips are heavier and will pack more moisture-free wood per digester charge.

It was shown how cooking tables may be designed with the aid of a weighing device so as to secure a close control of the ratio of alkali to moisture-free wood per digester charge.

The discussion gave two methods of correcting for chip moisture variations: first, by maintaining a definite ratio of chip moisture to moisture-free wood, second, by maintaining a definite ratio of digester liquid volume (chip moisture, weak black, and white liquor volume) to moisture-free wood.

Water and Waste Disposal

The first speaker in the afternoon to be introduced by C. C. Porter, Southland Paper Mills, the session chairman, was A. E. Drew, also of Southland. In his paper "Reuse of Water in Kraft Pulp and Paper Mills," Mr. Drew commented that in addition to the recognized function of water in papermaking, considerable quantities are required for the power plant, as a conveyor of pulpwood, for cleaning, cooling, drinking, and sanitation. For water economy every effort should be made to eliminate wastage, especially of fresh water, and to replace where possible with white water or filtrate from the various washers in the mill. They should be used as cooling and similar waters. By careful consideration it is possible to so reduce the water consumption that the reclamation of sewer waters is undesirable. It is to be recognized that the development of additional water supplies is generally more costly than the efforts to complete the reclamation of mill waters that would otherwise be wasted.

The next paper "Sulphate Pulp Mill Design for Abatement of Odor and Effluent Nuisances" was given by W. O. Hisey, South African Pulp & Paper Industries, Ltd. The recovery system recently completed and put into operation at the mill of the South African Pulp and Paper Industries, Ltd., was described by Mr. Hisey. This recovery plant was designed and installed with the intention of reducing, to the minimum, the odor and effluent nuisances which are commonly associated with sulphate pulp mill operation.

Black liquor oxidation is included in the recovery operation, and the oxidation tower is used as a "sulphur trap," in that all waste gases containing malodorous sulphur compounds are diluted with air, passed through the black liquor oxidation tower, and residual gases from this tower are burned in the recovery furnace. In this way a large proportion of the malodorous sulphur compounds which are normally discharged to the atmosphere are destroyed and their sulphur content is retained in the recovery cycle.

Contaminated condensates from the digesters and evaporators are blown with air in a packed tower, and the effluent is used as make-up water in a spray cooling pond. The odor nuisance from this effluent is negligible, and the quantity is less than 2000 gallons per ton of pulp produced. Even this small quantity could be reduced or even entirely eliminated since the purity is such that it could be reused in the causticizing system, or in pulp washing.

A cyclonic evaporator and a set of fume recovery towers have been installed following the soda recovery furnace. Experience to date has indicated that a recovery of more than 90% of the sulphur compounds in the gases leaving the furnace is obtainable in this system. The odor level of the stack gases is very low and is reduced still further by the introduction of a small amount of chlorine. A slight, but distinct "kraft" odor is still evident in the stack gases, although the nuisance so created is hardly more than would be the case with a boiler plant of the same steaming capacity burning a high sulphur content coal.

The measures undertaken to eliminate sulphur compounds from the liquid and gaseous effluents have resulted in a high degree of retention of sulphur in the system, with consequent maintainence of sulphidity with relatively low additions of make-up chemical.

The final paper of the conference "Problems of White Water Reuse from the Standpoint of Size, Alum, and Wax Size Utilization" was presented by Allyn R. Shelton, American Cyanamid Co. It was mentioned that as a system is closed there is the tendency for a buildup of the soluble salts, such as sodium chloride, or ions, such as sulphate. These usually affect the sizing adversely so that it is necessary to take steps to offset the conditions which cause an increase in the use of rosin size. As with the regular papermaker's size, the wet-strength resins are also unusually affected adversely by high sulphate ion concentration.

Mill Visits

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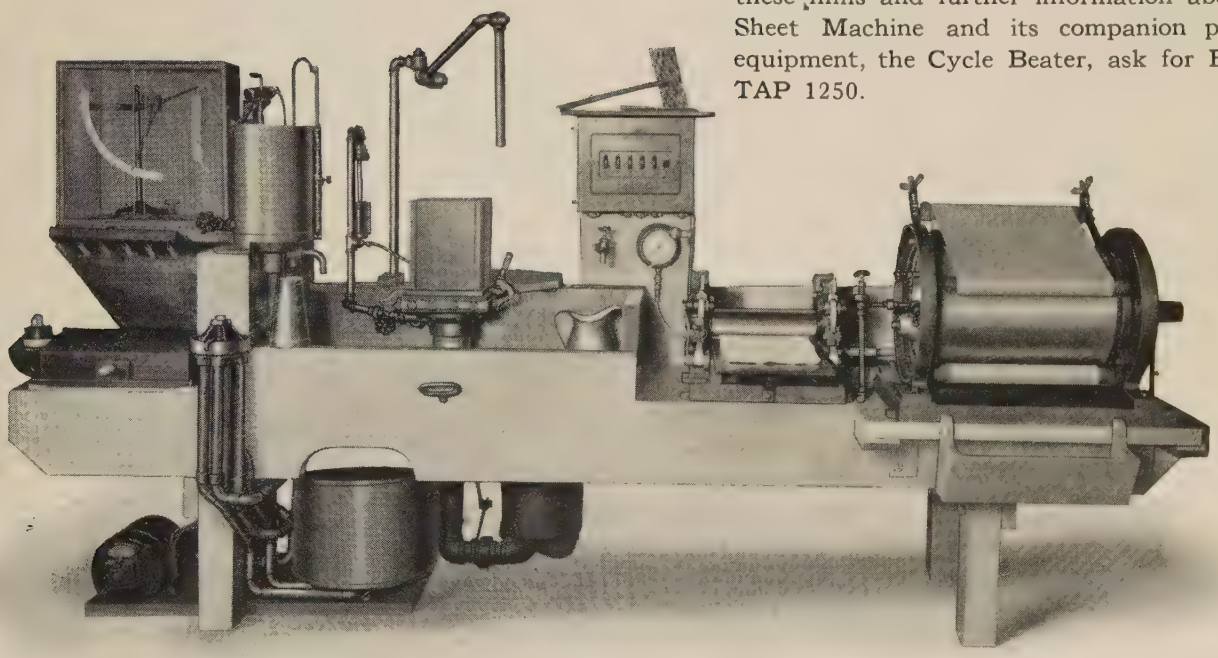

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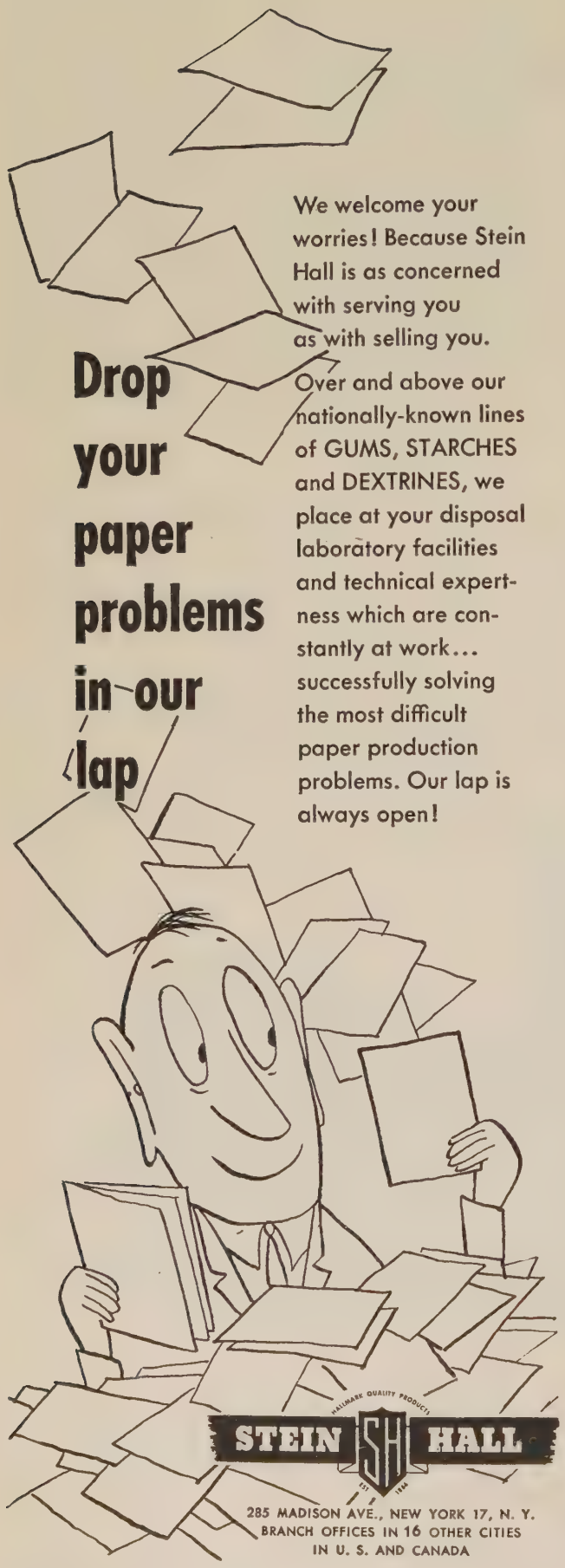
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luncheons were held. The speaker on Thursday was Harold Colee, Executive Vice-President of the Florida Chamber of Commerce. His talk highlighted the growth and opportunities for the pulp and paper industry in Florida.

On Friday, October 27, buses were provided to take the group to visit the University of Florida at Gainsville and then to the Hudson Pulp and Paper Co. mill at Palatka. In the evening there was a get-together party and dinner at Welaka through the courtesy of the Noble & Wood Machine Co.

This conference was so successful, largely because of the efforts of Henry Vranian, Chairman, the members of the TAPPI Alkaline Pulping Committee, and R. R. Fuller, program chairman. To them and to the participating companies, the Association is indebted.

Testing Conference

The following reports of the Testing Conference have been prepared by the chairmen of the participating committees. The conference was opened by James d'A. Clark, General Chairman of the Testing Division whose remarks follow:

Testing, the Path of Progress

JAMES D'A. CLARK

Everyone will agree that the increasingly progressive strides made by all industries during the past century have paralleled fairly well the increased employment and use of scientific men and methods.

Let us examine how progress in the quality or the quantity of manufactures, or indeed any progress whatever, comes about. It comes by one and only one way; by making and interpreting tests. This is the way, and the only way, that progress of any kind is going to be made in the future.

Since progress is born of testing, the value of testing or "proving" has long been recognized. Prove all things say the Scriptures, and hold fast that which is good. The greater value of formulating tests to yield quantitative rather than qualitative results was also a mark of the past century. As you all know, Lord Kelvin well expressed this in an address to the Institution of Civil Engineers in London in 1883, but his words are worth repeating: "When you can measure what you are speaking about and express it in numbers, you know something about it, but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind."

Our likelihood of making an improvement to a product can be estimated as being in exact accordance with our ability to make appropriate measurements. One needs to go back scarcely more than twenty years to find the time in our industry when the influence of scientific testing and measurements was negligible on those responsible for the production of pulp or paper. The quality of a sheet was judged by its feel, its appearance, its tear, its rattle, the tongue test and by practical use. The quality of a pulp was judged by tearing, by holding the edge up to the light to see how long the fibers were and in doubtful cases, if a wood pulp, by chewing a wad of it to ascertain if it had a "raggy chew." It must be admitted that in the hands of an old timer, these preuse tests for paper were fairly good most of the time as a guide for his own, but nobody else's thinking, but those for pulp were practically worthless. Under these circumstances, it is not surprising that progress was largely a one-man affair and was slow and difficult.

Today, we are better off in some respects but in others, not much. There are so many important properties of pulps, papers, and boards that we still cannot measure satisfactorily, and until we do find ways of measuring these properties accurately and precisely, we are not going to improve those qualities very quickly. It is almost certain that the manufacturer who makes the best tests for desirable properties of a product, will be the first to improve it.

This doesn't mean that one has to wait for a perfect test for some desirable property to get started with an improvement program. When, about seventeen years ago, I introduced the softness test at The Scott Paper Company, now TAPPI Standard T 451 m, no one else knew its limitations and shortcomings better than I did. However, it checked well with an independently devised test consisting of a squirrel cage crusher which read in terms of work done to corrugate a sheet of tissue, and it correlated

JAMES D' A. CLARK, Research & Development Engineer, Longview, Wash.

fairly well with a comprehensive series of manually rated samples. It did not check when plain tissues were compared with embossed ones and could well have been thrown out on that basis. However, it was considered that if the operators would accept it as a measure or score of their efforts toward improving the softness, and the engineering and technical group would accept it as a measure of the changes we made to pulp furnishes or to processing, on the whole, changes which improved the test values, would most probably improve the real softness of the towels and tissues. This turned out to be the case and every year since then there was a noticeable increase in the value and the uniformity of the test figures and a corresponding improvement in the products. As a matter of interest, I understand that the test figures have now more than doubled. Those knowing all the circumstances, would unhesitatingly agree that without this or some other numerical measure of the property desired, progress would have been much more difficult and not nearly so rapid.

The accuracy and precision of a test are, of course, not the same. A fine quality, well-regulated watch with its minute hand missing, would be accurate but not precise. A poorly regulated, cheap watch, complete with minute and second hands, would be precise but not accurate. The high cost of inaccuracy induced by some short cuts or "quick" tests is not always appreciated. A while ago, a friend proudly told me of a list of short cuts he had devised for TAPPI Standard T 205 m, employed for sheetmaking. He used felts instead of blotters, saved a few minutes in disintegrating the pulps, omitted the first pressing, saved a couple of minutes in the second pressing and so on, and finally dried the sheets on a hot plate to save more time. A year later, on a certain important series of tests on mill prepared stock, he and two other senior technologists spent over two hours discussing whether or not it was feasible to believe that three curves, plotted from the test sheet data, really crossed over each other in the way they did. The matter was pursued by directing that three new series of tests be made, involving another disturbance to mill equipment and interference with the operators and production. More of the technicians time was used up in making twelve more batches of test sheets—but of course with appreciable savings realized in sheetmaking time and in blotters. The new results didn't check the old ones very well, so after another lengthy discussion by the staff, an uncertain agreement was reached as to what the fact actually may have been. However, with all that sheetmaking, there was no doubt whatever that with the short cuts, a lot of time had been saved there, that together with the undisputed saving of at least four dozen blotters.

I understand that my friend is still using his modifications to the standard method, not because he is quite so pleased with them as he was, but he now explains that by this time he has built up a great mass of test data, which are too valuable to jeopardize by changing the test method. Moreover, if the methods were changed, everyone in the mill would have to be re-educated to the new values! This! and the geophysicists tell us that a papermaking and using mankind will flourish on this earth for probably another two million years.

The penny wise policy of testing just recounted not only constitutes a waste of senior men's time but what is even more important, the lack of accuracy or precision resulting, sometimes causes the missing of a golden opportunity of seeing where some small improvement might be made. Today, it is not often that the quality or the production of a product can be enhanced by one big improvement; usually progress is made by a succession of small steps. Where the accuracy of a test has been subordinated to labor or time saving, often the reality of some small but real difference in the test results is questionable and thus not pursued. Acceptance of the difference as being real, often means the chance of a better understanding of some obscure property and hence the chance of effecting some improvement to the product. By this, I am certainly not advocating that a lot of time be spent on elaborate testing. On the contrary, and by way of example take pulp testing. I am sure that for a given required degree of accuracy and precision, most time can be saved by taking every precaution to make the most uniform and reproducible test sheets presently possible, for which I believe the steps are laid down in TAPPI Standard T 205 m. The gains would be made by frequently checking the calibration and the operation of all the testing equipment, and, as head of the technical group and responsible for the interpretation of results, and, no matter how busy I was, I would either do myself, weekly, or delegate this only to a trusted colleague and even so, take time myself to discuss his findings weekly. In this way by minimizing systematic test errors, I would save the operator's time by permitting him to make fewer test sheets for each set and consequently calculating and making fewer bulk, burst, tear, tensile and fold tests and save a whole lot of my and the other senior members time wondering whether unexpected test results were actually so or not.

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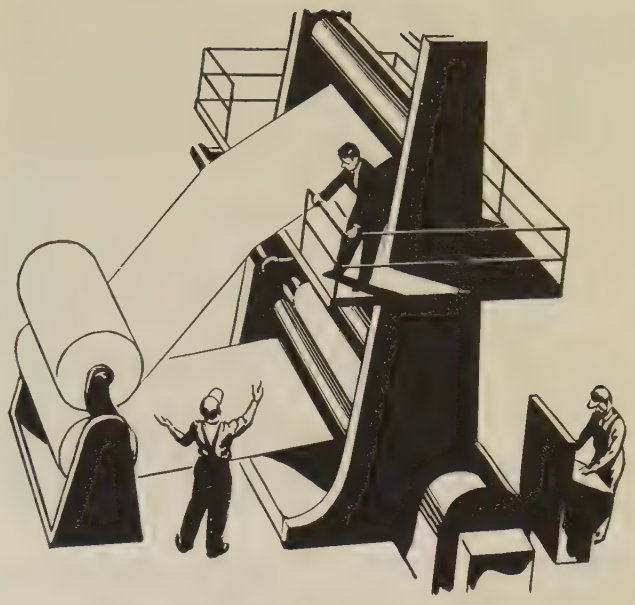

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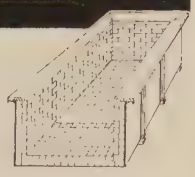

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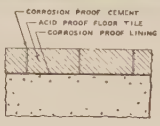

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agree, I should like to maintain a policy of having only well-tried reliable and accurate tests in the first category, and of being satisfied to leave others indefinitely as Tentative Standards if they are in any way suspect. Suggested methods constitute an excellent category for the purpose of providing an airing for new or compromise methods to invite criticism and so that they may be tried and amended if necessary before advancement. The Routine Control Tests should comprise only rapid procedures of dubious accuracy for general or reference use. There should be no hesitation on the part of a Committee Chairman to recommend transfer of any method under his jurisdiction from one category to another. Routine tests should be looked upon as a source of future standards for properties not presently covered and the adoption of a method as a TAPPI standard certainly doesn't mean that it is to be there forever. On the contrary, every once in a while, it is desirable to examine each standard and see if it doesn't require touching up, refurbishing, or even hauling off its pedestal.

Let me presume to give some counsel to the younger men in the matter of formulating a new test method. First, make very sure what precisely is the property you wish to measure; second, read up about it and its related properties; third, carefully consider every possible means thus disclosed of measuring the desired property; fourth, select the most promising means, that is the means which most closely simulate the end use for that property and which gives its best measure; fifth, formulate in your mind the most accurate and precise method possible with which to make the measurement; sixth, write it out in minute detail and at the end of each step consider every possible interference to the accuracy of measurement and try to amend the procedure to circumvent all of them; seventh, simplify, condense, and shorten the method as much as possible without sacrificing accuracy, precision is a less important consideration; eighth, try out the method on at least three samples including a pair having the widest possible differences procurable; ninth, if the results are satisfactory, have a co-worker try the method under your observation, using your written method as his only guide and without a preliminary demonstration or explanation. Finally, modify the wording where necessary to make any doubtful step clear and definite to the other and then, if possible, put the method into operation for a period to secure additional experience and data.

In a well run technical department, every method used should be written up on this basis if it has not been published. A complete set of these tests should be kept in a special working book in which every change or improvement should be carefully noted, together with the date, so that in the future, old data can be studied in the light of the actual methods used to secure them. Having done this, I am tempted to add that for the good of the Association, if not of your soul, whenever possible and with the company's permission, turn one of these methods over to the appropriate TAPPI Testing Committee.

In conclusion, let me refer again to an earlier statement during these remarks: "It is almost certain that the manufacturer who makes the best tests for desirable properties of a product, will be the first to improve it". This statement seems to be the more true when we realize that except by sheer accident or good luck, progress begins only after a study of test data suggests that some change in the process of manufacture has been, or could be beneficial. Progress is made when the change is identified and subsequent test data confirm its beneficial effect. Without tests therefore, progress is most unlikely; moreover, it is obvious that the more and the better the test methods employed, the faster will be the steps forward. To provide this, Gentlemen, is presently our task and our privilege.

Chemical Methods Committee

The Chemical Methods Committee discussed five topics in the two sessions held Friday, Sept. 15, 1950.

I. The determination of the moisture content in paper pulp T-208, T-412, and T-3. Dr. G. Broughton, Lowell Textile Institute, Lowell, Mass., was leader of the round table discussion on the topic of the moisture determination of paper and pulp. He introduced the topic by presenting a large chart comparing various TAPPI, A.S.T.M. and British methods on a large number of points such as sampling, sample size, precision, temperature of heating, type of oven, etc. The common practical methods included:

1. The oven-drying procedure usually at 100 to 105°C.
2. Toluene distillation methods.
3. Karl Fischer Method.

Dr. Broughton reported that the American Chemical Society has recently issued a revised procedure for the deter-

Chemical Methods Committee meeting, Milton Fillius, Chairman, by window

mination of moisture. Also, they are working on a tentative procedure involving the Karl Fischer reagent. TAPPI has been requested to cooperate in the testing of the Karl Fischer reagent. As a result of the discussion it was decided to cooperate with A.C.S. fully on these and other points. Other slower or more highly specialized methods were also briefly described. These were all dismissed, however, as possible TAPPI standards.

In appraising the methods the problem of the sampling error was mentioned but the details of the sampling problem were not discussed. They are particularly involved in the T-210 which is not under the jurisdiction of the Chemical Methods Committee. The loss or pickup of moisture during the transfer of the samples to and from the oven was also singled out as a very important problem. In removing samples from the oven the weighing bottle should first be carefully stoppered. The possibility of using an analytical balance attached to an oven was cited as the preferred procedure. Dr. Broughton also reported on work done at the Lowell Textile Institute on moisture determination of paper. The data were evaluated statistically and lead to the conclusion that even when all precautions are taken, there still is considerable variation from sample to sample on a material obviously uniform in moisture content. The precision of moisture methods has probably been exaggerated in some quarters. This is also pointed out by a report in the British Paper Trade Journal of January 1950, in which a similar committee of the British paper society presented a long report on sampling and testing paper for moisture content. This article will be studied carefully in preparing the revisions of TAPPI moisture methods. Additional results obtained by the distillation technique using toluene were presented and compared with those obtained by oven drying. The distillation method consistently gives higher results. The distillation technique is essential, however, in handling samples which contain volatile materials such as glycerol, unless the Karl Fischer procedure could be applied to such samples. As a result of the round table discussion the following things were decided:

1. To cooperate fully with A.C.S. in their program on the regular oven method as well as on the testing of the Karl Fischer procedure.

2. To submit a revision of T-208, for the moisture content of pulp including details for an oven-drying method. T-412 for the moisture content of paper will also be slightly revised and submitted to the members of the committee for their discussion and comment.

The comments and suggestions of TAPPI members on these moisture methods would be appreciated by the committee.

II. The distillation step in the pentosan procedure T-223.

The distillation step in determination of the pentosan

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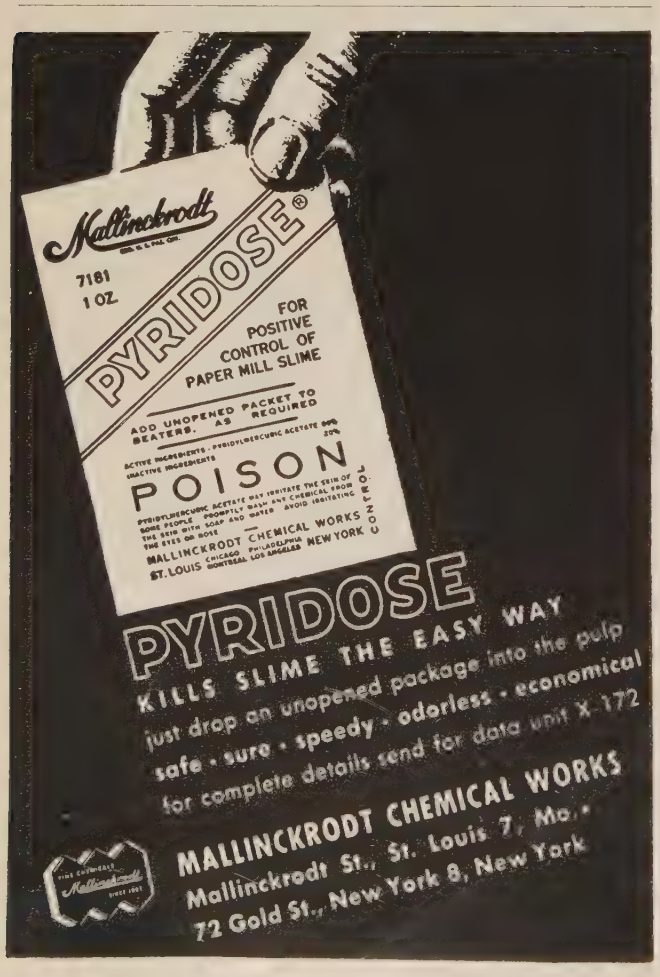
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content of pulp, T 223. Dr. O'Brien of Eastman Kodak Company led the discussion on this topic. Many highly refined pulps have a very low pentosan content, and some attempts have been made to improve the precision and accuracy in the determination of these very small amounts. There are some members of TAPPI who are interested in obtaining a very precise value for the pentosan content when it is of the order of one to two per cent, and think they could attach significance to differences of the order of two to three tenths of a per cent. The present TAPPI method T 223 does not seem to be capable of giving this precision.

Some data were presented on the change in the composition of the hydrochloric acid in the distilling flask during the course of the two-hour distillation. It starts off at 3.5 normal (12%) but during the course of the distillation the hydrochloric acid works up to that of a constant boiling mixture, namely about 20%. In fact, the hydrochloric acid concentration is approximately 20% during at least one half of the distillation period. After each 30-ml. addition of 12% HCl the composition reaches 20% again at the end of one minute additional distillation. This change in the composition of HCl during distillation is well known and is probably fairly reproducible. However, the time required to reach approximately 20% HCl probably varies from one distillation to another. In an attempt, therefore, to obtain a precise method for low pentosan pulps, it was deemed advisable for the committee to consider every change in the distillation step which might lead to more precise results. 12% HCl can be added to the flask at the beginning of the distillation and then a slightly weaker hydrochloric acid solution dropped in continuously over the two-hour period. If the weaker acid is of such a strength that the concentration in the flask is maintained at 12% at all times, the results are very low and there is no evidence of charring in the flask. On the other hand, if constant boiling HCl is used and constant boiling HCl added drop-wise during the course of the two hours, the results are very high and a charring occurs early in the distillation. If a concentration of 16% HCl is selected as the initial strength and 12% HCl is dropped in continuously over the two-hour period, it has been found that the concentration of the acid will be maintained at 16% for the two hours. A slight charring occurs after one hour and by the end of the two-hour period there is a definite blackening of the sample. The results obtained by this technique compare favorably with the official procedure T 223 as far as the level of the pentosan results obtained is concerned. It is assumed that 30 ml. of the distillate is collected each ten minutes, and that the rate dropping is so regulated that 30 ml. is also added. Several participants at the round table discussion agreed that much of their work was on pulps having a very low pentosan content and that any improved technique which could increase the accuracy of the pentosan determinations for such pulps would be welcome. There was, however, no general dissatisfaction with T 223. It was decided that more work should be done in one laboratory in an attempt to develop a procedure which could be applied to low pentosan pulps. It was suggested by the chairman that a very large sample could be used for all pulps running below 2% and this might greatly improve the reliability of the results. Any procedure developed would probably not be an official procedure and would not displace T 223, but would be a special method used by a relatively small group of workers.

The above-mentioned changes in the distillation step, if they continue to prove more precise combined with the large sample size, and if this proves to be advantageous, might be incorporated in such a special pentosan procedure. An additional report on this subject will be presented at the February meeting.

The committee would like to hear from those interested in a modified pentosan procedure of this type.

III. The bleach requirements of pulp.

This was a discussion of T 202 Chlorine Consumption of

Pulp, T-214 Permanganate Number of Pulp, and T-219 Bleach Requirements of Pulp. The discussion was led by Professor C. P. Donofrio of the New York State College of Forestry, Syracuse, N. Y. Professor Donofrio presented the distinctive features of each of these three standard methods. T-202 is essentially the same as a Roe chlorine number, T-214 is the permanganate number which proved to be the most widely used of the three and does not involve the use of chlorine but rather measures the quantity of permanganate consumed by a pulp. The third procedure—the bleach requirements of a pulp—requires the use of chlorine and, in addition, involves the measurement of the brightness of the bleached sheet.

One of the strongest points made by Professor Donofrio was that the correlation of the results obtained by any one of these three methods to any actual program of bleaching in a mill must necessarily be empirical. The bleaching in most modern mills is done in many different steps and it is impossible to go from the amount of chlorine consumed in a one step test to the total chlorine required in a process involving many steps.

Since any application of test results to experience is, thus empirical, there is a strong argument for using the most convenient test method to obtain an empirical number. This seems generally to be recognized as the permanganate number, T-214. Professor Donofrio brought out that permanganate numbers are not consistent with chlorine numbers for pulps partially cooked or cooked by different procedures. This is a rather serious theoretical objection but, since the tester ordinarily knows the cooking process used on the lot of pulp being tested, it is possible to go from the permanganate number to mill operation by the use of the proper empirical equations.

The bleach requirement for pulp T-219, which measures the quantity of oxidizing agents required to produce a certain brightness, is the least frequently used, based on the results of the TAPPI survey. The consensus of the men present seemed to be that T-202 and T-219 should not be dropped but that a subcommittee should concentrate on T-214, the permanganate number of pulp. Although the procedure in general was considered fairly satisfactory, there were some suggestions made for the revision of T-214. The amount of permanganate to add to pulps having a high chlorine demand would be one topic to be considered in any revision. The revision of this standard will be considered again at the February meeting. The comments of TAPPI members on this problem would also be appreciated.

IV. The interference in the analysis of paper caused by wet-strength resins.

Dr. C. S. Maxwell of American Cyanamid Company and Dr. O'Brien of Eastman Kodak Company presented the different aspects of the interference from wet-strength resins in ordinary paper testing methods. Alpha, beta, and gamma-cellulose in paper and copper number, are seriously interfered with by the presence of wet-strength resins on the fibers. The wet-strength resins incase the fibers with a material which resists the action of the alkali and other reagents. Alpha-cellulose results frequently come out 97 to 99% regardless of the actual value. Copper number results are low. Dr. Maxwell brought out that acidity values by the hot extraction method are sometimes decreased due to the presence of wet-strength resins. It was also pointed out that the determination of gelatin in the presence of wet-strength resins is complicated since both are frequently determined by Kjeldahl method based on total nitrogen presence.

During the course of the discussion it was brought out that none of the common solvents used for extracting paper will remove the wet-strength resins. Such liquids as benzene, alcohol, and acetone do not dissolve polymerized melamine formaldehyde. From the files of the TAPPI Microscopy Committee in connection with staining of fibers, it was re-

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ported that from work done at the American Cyanamid Company, hydroxylamine hydrogen chloride can be used to remove most or all of the melamine formaldehyde present in paper, thus yielding a valid C stain test. This solvent was tested briefly in the Paper Service Department laboratory at Eastman Kodak Company. Provided the sample was first extracted with benzene to remove rosin, the hydroxylamine hydrogen chloride was fairly effective in removing the wet-strength resins. The total extraction treatment, however, did affect the alpha-cellulose results when applied to a sample of pure pulp. Alpha-cellulose values were lowered approximately 1%. This lowering, however, might be fairly constant and in which case it can be applied as a correction. More work is planned on the use of this reagent before the February meeting. Its application to copper number values will also be tested.

It has also been reported in Chemical Methods Committee correspondence that the cold extraction method for acidity T-435 can be used in the presence of wet-strength agents without interference from the resin. However, the hot extraction method does lead to slow hydrolysis which forms alkaline material and lowers the acidity value. The committee decided to look up this information and have it also available at the February meeting. The chairman volunteered to do some more work on this problem before February and try to present a more definite opinion as to the effectiveness of hydroxylamine hydrogen chloride for removing the resin.

The determination of gelatin in the presence of wet-strength resins was also discussed. Dr. O'Brien described a possible method which might be applied to papers containing both blue and resin. A total nitrogen content is determined by a modified Kjeldahl method (*1*). Another sample is then treated with sodium hydroxide to remove the glue after which the total nitrogen analysis is repeated. The latter value gives only the wet-strength resins. The gelatin can be obtained by difference.

The comments of workers having experience with this problem would be very much welcomed by the subcommittee working on this problem.

V. A more rapid nitrogen procedure for the determination of organic nitrogen in paper, T-418.

Considerable interest was shown in the rapid method for gelatin in paper (*1*).

A micro sample of paper is destroyed with hydrogen peroxide and sulphuric acid instead of the regular Kjeldahl digestion. After some discussion it was decided that the new procedure has not been adequately tested on a sufficient number of compounds. In fact, it has been proposed only for the analysis of a small amount of gelatin or wet-strength resins fairly evenly distributed throughout a paper sample. Whether the correct answer would be obtained for pure gelatin in the absence of paper or for other nitrogenous compounds, has not yet been determined.

Also, the hypochlorite solution used in the method is not stable and, therefore, cannot compare favorably with the Kjeldahl method. The Kjeldahl procedure has been tested for a great variety of organic compounds. Therefore, no serious consideration could be given to the substitution of the rapid micro method as a referee procedure in place of T-418. However, it was suggested that the rapid method for nitrogen in paper be submitted to the chairman of the TAPPI committee on rapid mill methods. It might find application to the control work in paper mills.

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MILTON F. FILLIUS, *Chairman*
Chemical Methods Committee

Pulp Testing Committee

A joint meeting of the Pulp Testing and Microscopy Committees was attended on September 13 by thirty people, among whom were six members of the Pulp Testing Committee and four members of the Microscopy Committee. The discussion leaders were C. E. Brandon, Howard Paper Mills, Chairman of the Microscopy Committee and L. V. Forman, Scott Paper Company, Chairman of the Pulp Testing Committee.

The topic for discussion was T 213 m-43 Dirt in Pulp. This meeting was a continuation of the subject as discussed at the First Testing Conference held in Pittsburgh.

After presenting a short agenda of the Pulp Testing meetings to be held at this Second Testing Conference, Mr. Forman asked the question as to how many present at this meeting were satisfied with the present TAPPI Standard T-213 for determining the dirt count of pulp. None of

Pulp Testing meeting, Loren V. Forman, Chairman, at right

those present indicated satisfaction. Mr. Brandon then made the statement that he had asked at an Ohio Section TAPPI meeting how many used the TAPPI method and in this case he also received the same negative answer. Mr. Forman mentioned that he would like to read the minutes of the Pittsburgh meeting and then to briefly review the answers to a questionnaire which was sent out to the Pulp Testing Committee a few months ago. The first point covered was sample size and the five answers received were read. H. A. Smith, Mead Corp., asked the question as to whether handsheets were acceptable for the preparation of the dirt count specimen. A. E. Bachmann asked whether handsheets were specified in the standard method and if not, why this would not be a good thing to do. At this point Mr. Brandon brought up the suggestion that in making handsheets, extraneous dirt might be introduced. Also if there was only one dirt speck in the sample being analyzed that it might be missed. Mr. Bachmann stated that in the case where there was only one dirt speck present it would not be too important if it happened to be introduced. Mr. Brandon countered with the remark that one to three large specks per pulp sheet are definitely objectionable in the manufacture of fine papers. Mr. Bachmann stated that in his opinion the problem was how much homogeneous dirt there was in a lot of pulp. Then Mr. Forman continued with the remaining questionnaire answers. The subjects covered were the sample area, the manner of inspection, the geometry and equipment for inspection, illumination, counting and measurement, identification and reporting. After this a discussion of these topics followed.

Concerning sample size, one suggestion was that statistical sampling should be considered. J. d'A. Clark brought up the point that the subject under discussion was a referee method and that in his opinion the equivalent black area method was the only good referee basis. Likewise, he cautioned that transmitted light should not be used and that the surface dirt as counted by reflected light was proportional to the total dirt in the sample. R. I. Thieme, Soundview Pulp Co., remarked that market pulp does not contain a large amount of dirt, and that in his opinion transmitted light should be used for making the dirt count. He pointed out that all of the West Coast mills are using transmitted light and that he is not in agreement with Dr. Clark that surface dirt is necessarily proportional to total dirt. The showers on the pulp machine can distribute dirt differently in different areas of the pulp sheet. Showers can actually cover up dirt in some cases.

Mr. Thieme stated that because of pulp cleanliness today, a sufficiently large sample of pulp must be tested. He mentioned again that transmitted light had been found best in making dirt counts in his mill and that it is uniformly used on the West Coast. The heaviest pulp sheet being made today, he mentioned, was 0.050 inch.

The next important point covered had to do with the area concept of counting dirt—should small, medium, and large particles be stated in the dirt count or should only the total equivalent black area be reported. Mr. Forman mentioned there were not yet enough data available to the Committe to show the relative merits of these two possibilities. He pointed out that there was no need to go to a tedious method for counting dirt area unless steps were taken to attain the same degree of accuracy in other phases of the procedure, such as sampling.

The above covers the remarks made during the morning session.

The first point discussed during the afternoon session was the limit of size of particles counted. In the present TAPPI Standards, dirt in paper is counted in particles down to 0.04 sq. mm., while in pulp testing it is standard procedure to count to only 0.08 sq. mm.. The question was whether to revise the 0.08 sq. mm. limit to 0.04 sq. mm. or below. Mr. Rochow, American Cyanamid Co., remarked that the limit of resolution of the eye is a particle 0.04 sq. mm. and that he would recommend a limit of 0.04 sq. mm. Dr. Larson, Detroit Sulfite Pulp and Paper Co., stated that it is possible to see particles down to 0.02 sq. mm. and that they count to 0.03 sq. mm. on paper. After further discussion, it was tentatively decided that the lower limit should remain at 0.08 sq. mm., and also that reflected light was suitable.

The next point discussed in the afternoon session was the method of reporting the dirt analysis. C. E. Brandon, Aetna Paper Co., made the point that if handsheets were used for the dirt count, the dirt should be specified by weight and area of the sample. Mr. Thieme suggested expressing the dirt area per unit weight of pulp. Mr. Brandon remarked that the referee method should be determined on handsheets and that for routine tests the pulp sheet could be used. Mr. Thieme remarked that if handsheets were made, the dirt should be specified per unit weight of pulp. Then it would not matter whether handsheets were made or not.

The next point had to do with the preparation of the handsheets for dirt determination. H. A. Smith, the Mead Corp., questioned—why not use the optical method for the preparation of the dirt sheet (T-218). The Pulp Testing Committee is to look into this possibility. Dr. Larson stated that the method of disintegrating pulp was very important and that the British disintegrator worked quite well. Mr. Thieme remarked that the question of preparing 10 to 15 g. of pulp per disintegration instead of the 4 g. as specified in T-218 should be looked into. John Clouse made the statement at this point that they had determined dirt on brightness sheets and had found that the dirt count by this method was 40 to 50% less than usual. This was found in counting 40 to 50 sheets per sample. Mr. Brandon brought up the point that even though this is true, it may be closer to mill effects. After further discussion, it was definitely decided

that dirt should be determined on handsheets only for the referee method. The Pulp Testing Committee is to work out the proper procedures at their mills for disintegration, viewing, etc. Mr. Delforge, Gair Co., questioned whether the size limit should be set at 0.04 sq. mm. instead of the 0.08 sq. mm. figure if handsheets are used. Dr. Clark mentioned that the action in the British disintegrator will not reduce the dirt size in half. Mr. Rochow again mentioned that he recommended that 0.04 sq. mm. be the lower limit in the standard. Mr. Schroeder, Northwest Paper Co., stated that he thought that 0.08 sq. mm. was too large and that 0.04 sq. mm. should be the standard. Mr. Rushmore, Rogers Co., stated that it might be a good idea to ask the users of paper to establish the smallest particle size which would be objectionable. Dr. Larson brought up the point that a shive does not look as large as a speck. Mr. Brandon stated that the amount of work increased tremendously in counting to 0.04 sq. mm. and asked the question as to whether 0.08 sq. mm. would not give the relative ratings on pulp as 0.04 sq. mm., thereby reducing the work. Mr. Walker, Northeastern Paper Products, made the statement that he does not agree that 0.08 sq. mm. will give the same ratio as 0.04 sq. mm. Dr. Clark made the suggestion that for fine dirt the report should be made as a special case. Mr. Bachmann, Missisquoi Corp., asked if the number of sizes of various dirt particles would not follow the laws of probability. Mr. Forman pointed out that in picking any specification as to the smallest dirt particle to be counted, an arbitrary point would have to be chosen on the distribution curve below which pulp dirt either is not obnoxious or cannot be seen properly. Mr. Smith asked if it would be possible to count less sheets and to count to 0.04 sq. mm. Mr. Forman stated a sample size of 2000 sq. mm. would not be adequate for clean pulp and would be more than adequate for dirty pulp. Mr. Thieme brought up the point that the sample size should be based on the amount of dirt counted. The Pulp Testing Committee is to look into this possibility. Mr. Thieme stated that it is sometimes necessary to count 20 sq. ft. on clean pulp to have an adequate test.

The next point discussed was the method of illumination and equipment to be used. Both Mr. Schroeder and Mr. Forman favored the use of reflected light. Dr. Clark stated that a 50-watt bulb was too weak and he recommended that a florescent light of sufficient intensity be used. Mr. Forman mentioned it was necessary to avoid direct sunlight. Dr Clark stated that the sample being checked should be slightly movable so that shives could be located more easily and taken into account. Mr. Forman stated that the pulp sample being counted should be approximately perpendicular to the line of sight and that it should be feasible to specify the use of commercial bulbs for illumination due to the fact that they are so uniform, provided that the period of use be properly specified. Dr. Clark would like to see not only the size bulb specified but also the foot candles. Mr. Thieme stated that a definite type of reflector should be specified. Mr. Forman stated that the background must also be specified. Mr. Thieme and Mr. Brandon both favored the use of a black table with a white background behind the pulp sheet.

The next point discussed was whether or not identification should be a part of the method. The first question had to do with the shive count. Both Dr. Clark and Mr. Thieme pointed out that shives should be included in the general dirt count. Dr. Clark stated that perhaps a separate method for the determination of shives should be written up. For example, both Norway and Sweden have a screening method for determining them by weight. Mr. Thieme said that one way of handling the shive report would be to merely note on the dirt count report whether or not a large amount of shives were present. Mr. Brandon then asked if identification of specks and spots should be included in the dirt count method. Dr. Larson stated that he would not like to see the dirt identification included with the dirt count standard. Mr. Thieme suggested that an appendix should be attached to the dirt count procedure, giving methods for identifying dirt. Mr. Forman mentioned that one method for identifying dirt is to apply an iron stain to the pulp sheet and then to tabulate the various types of dirt seen under magnification. There is still a question as to whether two pulps with the same dirt count will give papers of equal dirt count. Of course, this will depend on the type of dirt present. Mr. Brandon stated that shives are not as bad as regular dirt and Mr. Smith mentioned that shives bleach out. A. E. Jones, Oxford Paper Co., stated that in his opinion, the shive count was very important.

After further discussion, it was decided that the method for specks and spots should remain a separate procedure to which a footnote reference could be made in both the pulp and paper dirt count methods. Mr. Jones stated that when concerned with dirt identification T-445 has been satisfactory in most cases.

This concluded the discussion for this day.

On Thursday morning, September 14—9:00 a.m. with thirty-two persons in attendance, the meeting was called to order by Chairman Forman. The topics for informal discussion were T 200 m-45 the Laboratory Processing of Pulp and T 205 m-47 Making Handsheets for Physical Tests of Pulp.

In the discussion of T 200 m-45, the Laboratory Processing of Pulp there was considerable discussion of the best procedures for establishing and maintaining the beater in calibration. There was general agreement that the procedure specified in T 200-m-45 for initial grinding was satisfactory. This provides that 120-mesh emery dust in pulp be used with a clamped bedplate to establish full contact and a good fit between roll and bedplate surfaces. It was suggested that some had found it advantageous to follow this initial grinding with a light treatment with finer emery. It was agreed that the final treatment should be a polishing of the tackle which could be achieved by beating a suspension of clean sawdust or pulp for many hours. The Pulp Testing Committee will prepare an addition to the method which incorporates this latter step and submit it for approval.

It was agreed that the above procedure was generally successful in producing a reasonably stable condition in a given beater. However, there remains considerable difficulty in getting agreement between beaters and in duplicating results before and after changing a bedplate. It was suggested that the shape of the lead mounting in which the bedplate is held was important in determining the angle of approach of the stock to the first bar of the bedplate. It was felt that this factor influenced the rate of refining in the beater. However, there was no definite evidence on this point available from the group. The Pulp Testing Committee would welcome any data on this point from any TAPPI member.

Consideration of this matter led to the question as to whether it is necessary to obtain identical rates of freeness drop and strength development on two beaters to have them in calibration. Mr. Forman suggested that in some cases where there was apparently some lack of agreement between two beaters, an analysis of strength properties as a function of apparent density showed them to be in good agreement. In other words, two beaters used on the same pulp gave different freeness and different strength at a given beating time, but gave the same strength at the same sheet density. The Pulp Testing Committee would welcome advice from TAPPI members as to their experience on this point.

In discussing the matter of sampling intervals to be used for the withdrawal of stock for freeness testing and handsheet making, Mr. Forman suggested that thought should be given to a possible change in the method. He reviewed the trends he had observed toward the existence of straight line relationships between strength properties and the logarithm of beating time, at least in the range of beating

times between maximum tearing strength and maximum bursting strength. Under these circumstances two possible revisions in sampling time would seem to be indicated. The first would be that the time intervals should be spaced more equally on a logarithmic scale, with sampling more frequent at the lower beating times and less frequent at the higher beating times. For example, the series 5, 10, 20, 40, 80 minutes might replace the 10, 20, 30, 40, 50, 60 minute series now specified, or the series 7.5, 15, 30, 60, 120 minutes might replace the series 15, 30, 45, 60, 75, 90 minutes now specified. The second possible change is the use of fewer intervals, at least for control testing, because of the fact that a straight line can be established by fewer points than a curve. However, for referee testing it may be necessary to continue the larger number of intervals and to base the interpretation largely on the level and slope of the straight line portion of the curve. It was pointed out that the use of semilogarithmic graph paper for plotting the data made the analysis of data as easy as the conventional analysis using linear graph paper. In fact it is easier to the extent that one is dealing primarily with straight lines instead of with curves.

It was generally acknowledged that the existing lack of knowledge and agreement on how to interpret pulp testing data is fully as serious as the lack of perfectly reproducible pulp testing equipment. Almost all of those present reported that they compare the strengths of various pulps at a given beating time or at a given freeness. Mr. Forman suggested that comparisons also be made at a given sheet density and the results reported back to the Pulp Testing Committee. He speculated that if two pulps were different in strength at a given time, a given freeness and a given apparent density, there was definitely a fundamental difference in the pulps. On the other hand, if they are different in strength at a given beating time and a given freeness, but the same at a given apparent density the two pulps might be fundamentally similar, but different in rate of response to refining, or if two refiners were used, they might be less similar than the two pulps. To evaluate these trends the Pulp Testing Committee hopes that those present as well as other TAPPI members will check them and advise the Committee in order that it may have a sound basis for recommending any changes in TAPPI Methods.

In discussing T 205 m-47, Making Handsheets for Physical Tests of Pulp, there were two topics of primary interest, vacuum couching and automatic pressing.

Objections to the currently specified couching technqiue are (1) the weight of the couch roll is objectionable, particularly in the case of women operators, (2) there is some danger of dropping the roll and damaging the wire or other equipment and (3) with a circular sheet the length of the nip under pressure varies as the roll moves across the sheet, even though a metal couch plate is used. An alternative procedure has been proposed which eliminates the use of the heavy roll. In this procedure, after the sheet has been formed it is covered by a couch blotter and a vacuum is applied to the sheet machine below the wire. After release of the vacuum the sheet adheres to the blotter and may be lifted from the forming wire. A description of such a scheme has been given by Clark in *Paper Industry* 29, no. 7: 992–994 (Oct. 1947). There was no first hand experience with vacuum couching for strength testing in the audience. Mr. Forman reported experience with its use on rectangular molds, but not on round molds. He pointed out that the Pulp Testing Committee would like to have evidence that vacuum couching does not alter the strength properties of a wide variety of pulps before writing it into the TAPPI method as an acceptable alternate procedure. It is hoped that any TAPPI members who compared vacuum couching with the specified procedure on the same pulp will advise the Committee of their experience.

Automatic pressing of handsheets was also discussed. Several procedures have been developed for actuating the standard press or similar presses by a hydraulic medium (air, oil or water) under conditions of automatic control which give the desired rate of application of pressure and maintain the desired pressure for the specified time automatically. Several in the audience reported the use of automatic pressing in their laboratories and all comments were favorable.

After some discussion of the details of design and construction, it was decided that the exact specification of the equipment was beyond the scope of the Pulp Testing Committee. It was decided that the section of the method on pressing should be rewritten in such a way as to specify only the times and pressures, leaving the details of the equipment to the individual user of the method. Such a revision will be made and submitted for approval.

May we repeat at this point a plea for comment from TAPPI members to the Pulp Testing Committee on these points, particularly in the case of vacuum couching.

The meeting of the Pulp Testing Committee on Friday, September 15, attended by 22 persons, was called to order by Chairman Forman for an informal discussion of two subjects: T 226 sm-46, Specific External Surface of Pulp and the writing of a method for the zero-span tensile strength of pulp handsheets.

A review of the status of the specific surface measurement revealed that while improvements have been made in the test, it probably needs further study and revision before it is advanced in TAPPI. One of the improvements which has been made is the use of asbestos to prevent the agglomeration of fines, particularly in highly beaten pulps, thus giving truer values in the results. Mr. Forman raised a question about the effect of boiling the pulp in the test and suggested that the temperature effect be checked for its effect on strength proper-

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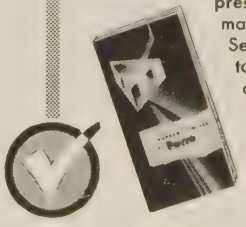

ties and freeness. If a silvering technique could be developed for use at lower temperatures, it should be checked against the present method.

Dr. Clark reviewed his experience with this test and suggested that the Pulp Testing Committee request a research grant from TAPPI for further study of the method. There was no experience with the method reported from the audience.

The zero-span tensile test was discussed by Messrs. Clark and Forman. There was no experience with the test reported by those present. An equipment manufacturer reported that several zero-span jaws had been sold. It was decided that the Pulp Testing Committee would consider writing a suggested method as soon as it had sufficient evidence from those who use the test to be assured of the readiness of the equipment and the utility of the test to justify this step.

A general discussion followed in which President Bachmann and others expressed the thought that the current status of all pulp tests should be reviewed to assess what present pulp evaluation procedures tell us about a selected series of pulps representing well-known types of pulp. The thought was that a series of pulps could be obtained by the Pulp Testing Committee, and submitted to a reputable testing institution for complete evaluation by all of the TAPPI chemical and physical tests for pulp. The identity of the manufacturers of the pulps would not be made known at any point in the study. As there seemed to be general interest in this proposal, the Pulp Testing Committee will attempt to follow through on it.

Following this meeting five members of the Pulp Testing Committee (Messrs. Charbonnier, Forman, Schroeder, Sheets, and Thieme) met to review the events of the three-day meeting and to discuss plans for the future. They adjourned at 12:30 p.m.

Loren V. Forman, *Chairman*
Pulp Testing Committee

Microscopy Committee

Three sessions of the Testing Conference held at Rochester, Sept. 13–15, 1950, were of particular interest to microscopists. The first of these was sponsored jointly by the Pulp Testing Committee and the Microscopy Committee and dealt with "Dirt in Pulp." The main portion of this session was concerned with the method for making a dirt count on the pulp but there was some discussion of the identification of the dirt after counting. It was agreed that a method for "Identification of Specks and Spots in Pulp" would be helpful if such a method could be prepared by the Microscopy Committee. It was decided that this could be done by modification of the present method for "Specks and Spots in Paper."

The second session was also jointly sponsored by the Pulp Testing Committee and the Microscopy Committee and dealt with the "Identification of Species" and the "Determination of Fiber Length." It was reported that a revision of T-8 for "Identification of Species" was being prepared. It was suggested that if anyone had any photomicrographs which showed the characteristics of the species, it would be welcomed by the Microscopy Committee for use in this method.

In the discussion of fiber length, Thomas Fyfe of the Eastman Kodak Co. presented a short discussion of the method they use for determining fiber length. The fibers are stained with Herzberg stain, aligned on a slide and the frequency of occurrence of each length of fiber is determined. Fibers under 0.1 mm. in length are not considered. Various methods of analyzing the data were given but it was pointed out by Mr. Fyfe that the cumulative curve was found to be the best method. A statistical study was made to determine the reproducibility of the test.

N. F. Wilson of the Alton Box-Board Co. next presented a method of determining fiber length which is used in their mill

Microscopy Committee meeting, C. E. Brandon, Chairman, standing

for routine control purposes. This method consists of taking a picture of the fiber using the slide in a 35 mm. photographic enlarger setup to magnify exactly 10 times. Those photographs can then be examined for average fiber length and filed for future reference. The method is relatively inexpensive and usable for control purposes.

It was pointed out that the method used by Alton Box-Board Co. required only about 20 minutes to make the photograph and the relative length could be told at a glance by an experienced person. Dr. Clark then explained the method he has used to measure the length of the fibers by measuring around curves on the screen rather than straightening the fibers in the first place. It was pointed out that this was also quite rapid. Mr. Wilson's method will give a record for a cost of only about five or ten cents per picture which can be filed for future reference.

The use of the classifier for fiber length was then discussed. Dr. Clark stated that after obtaining a few preliminary factors, a fiber length determination could be made very rapidly using the classifier. In the discussion it was stated that the "fiber length index" is fairly good but is influenced by flexibility of the fiber and is not as accurate as the classifier.

In using the classifier, a separate factor is needed for each type of pulp and this factor is effected to some extent by the degree of beating but the shift in factors due to beating is not significant. It can be used for mixed pulps by calculating the proper factors. Because the middle fractions remain almost constant, one screen will give almost all the information needed.

In concluding the discussion, Loren Forman of the Scott Paper Co. stated that he considered the microscopic method the one which should be used for a referee method. However, for mill control work the use of the classifier is more desirable. The difficulty is in interpreting the results. The microscopic method should be used along with the classifier in an effort to correlate the information. He also questioned whether fiber length is really the important factor or whether cross section, shape, density, fibers per gram, etc., might also be of importance.

The discussion Friday morning centered around Method T 401-m, "Fiber Analysis of Paper." It was found that many of those present at the meeting do not use "C" stain. Most of those who do use it also have used other stains in connection with it. Other stains used included Herzberg, Selleger, Lofton-Merritt, Bright, Wilson, Sutermeister, and Hubner's stain.

Tests were reported by the chairman showing that there was considerable disagreement in results on the same pulps tested with the "C" stain indicating that some additional stains were necessary. Many desirable changes in the present method for "Fiber Analysis" were discussed and will

be incorporated in the new method which is now under consideration.

At the close of this session there was a brief discussion of the microscopic method for "Filler Analysis." It was pointed out that this is a very rapid method which has been in use in some laboratories for several years. Photomicrographs of various fillers were shown.

C. E. Brandon, *Chairman*
Microscopy Committee

Nonfibrous Materials Testing Committee

The following is a brief report of the meeting of the Nonfibrous Materials Testing Committee held in Rochester this September.

Three principal meetings of the nonfibrous committee were scheduled to take place—one for starch testing, one for clay testing, and one for rosin size testing.

The session for clay testing was called off because several members of the committee could not attend but active sessions were held for starch and rosin size testing.

The first part of the session on starch testing was taken up by Dr. C. C. Kesler, subcommittee chairman, who reported on a questionnaire which he had sent to over 100 men in the paper industry requesting them to mark the tests which they considered of most importance. As a result of this questionnaire and discussion at the session, it was agreed that the following test procedures would be included in a starch testing method to cover beater starches, coating starches, calender and surface sizing starches but to exclude starch adhesives. The methods to be described include sampling, moisture determination, ash, foreign material on both uncooked and cooked dispersions, pH on both uncooked and cooked dispersions by both the colorimetric and potentiometric methods, cold water soluble, protein and viscosity methods. Viscosity methods were designated as the most important but they are also the most difficult to standardize upon. It was decided at the session to adopt the corn industry's research foundation viscometer as the standard instrument for referee purposes but to list a number of other instruments which are suitable for measuring viscosity of starch and to include recommendations for the use of all these instruments. Some of the other instruments which will be described are the Brabender Amylograph, Brookfield, Stormer, McMichael, Scott, Dudley, Ford, Engler and Saybolt. It was decided wherever possible to include cuts of the different instruments in the procedure.

A method for measuring reducing sugars was also requested but it was decided to put this method in an enzyme testing procedure to be developed later and refer to it there. A number of the men reporting on the questionnaire requested that specific tests be included to measure such properties as pigment suspending power, pigment bonding strength, retention of starch in a fibrous furnish, etc., but it was decided that such testing methods are not suitable for TAPPI Standard Methods. However, it was decided that the committee should attempt to work out procedures for measuring these properties and to include the methods in TAPPI routine control methods. Some of the men in attendance at the Starch Session are as follows:

W. C. Gallagher, A. E. Staley Mfg. Co.
K. H. Hunt, West Virginia Pulp & Paper Co.
F. E. Culp, Consolidated Water Power & Paper Co.
L. L. Larson, Detroit Sulphite Pulp & Paper Co.
C. E. Crawford, Bloomer Bros. Co.
L. M. Tyler, Howard Paper Mills
J. D. Parmele, St. Regis Paper Co.
William Schoenberg, Lord & Schoenberg
C. C. Kesler, Penick & Ford
C. S. Maxwell, American Cyanamid Co.
A. E. Jones, Oxford Paper Co.
H. R. Wheeler, Jr., Clinton Foods, Inc.
P. S. Bolton, Robert Gair Co., Inc.
D. D. Cameron, Hercules Powder Co.
C. E. Peterson, Riegel Paper Corp.
D. S. Dieffenderfer, Dixie Cup Co.
Abbott Byfield, Kimberly Clark Corp.
P. D. Applegate, Hercules Powder Co.
S. Kukolich, Lee Paper Co.

One of the subjects discussed at the meeting was an enzyme testing procedure. There has been some objection to undertaking the development of a method for testing enzymes but it was agreed at the meeting to initiate work on a suitable testing procedure. It was agreed that a subcommittee should be organized for this purpose which should include a number of men from the enzyme manufacturers. Some progress has already been made in setting up this subcommittee.

At the session on rosin size testing it was reported by D. D. Cameron, subcommittee chairman, that the method on rosin size analysis has been rewritten to take care of objections which have been voiced regarding the calculation of free rosin in the size. Mr. Cameron is putting the finishing touches on the method so that it can be submitted for vote. The subcommittee on rosin size has been investigating the development of a method for testing rosin wax sizes. It has pointed out that there is no present method which is acceptable and that in fact there is no particular need for such a method because of the very small amount of rosin wax size which is manufactured. However, this subject is still under consideration and work is being done by the rosin size manufacturers to develop a suitable method for determining the amount of wax in rosin-wax mixtures Some of the men attending the rosin session were as follows: M. Insalaco, Haloid Co.; K. H. Hunt, West Virginia Pulp & Paper Co.; H. R. Wheeler, Jr., Clinton Foods, Inc.; P. D. Applegate, Hercules Powder Co.; W. A. Kirkpatrick, Allied Paper Mills; E. I. Stearns, Calco Chemical Div., American Cyanamid Co.; D. D. Cameron, Hercules Powder Co.; F. E. Culp, Consolidated Water Power & Paper Co.; C. C. Kesler, Penick & Ford, Inc.; C. S. Maxwell, American Cyanamid Co.; C. M. Myers, Hollingsworth & Whitney Co.

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Part of the meeting was devoted to a discussion of future work to be undertaken by Nonfibrous Materials Testing Committee. Some of the projects which were suggested in addition to those which have been mentioned at previous meetings are a method for testing adhesives, a method for testing proteins such as casein, soybean protein, soy flour, animal glue, etc. and a method for testing latices for use in paper coating. It will be necessary to check whether these projects are suitable for the Nonfibrous Materials Committee.

James P. Casey, *Chairman*
Nonfibrous Materials Testing Committee

Optical Properties Committee

Approximately 20 individuals including 4 committee members attended the Optical Properties Committee Session. Three items were presented and discussed.

1. Proposed Standard for Measuring Specular Gloss of Paper at 75°.

A new standard for measuring the gloss of paper is needed by the industry primarily for two reasons:

(a) The manufacture of the Ingersoll Glarimeter on which Tappi Standard T 424 m-45 is based has been discontinued and there is some doubt if it will again be available.

(b) The Ingersoll Glarimeter was primarily designed for use with low gloss papers. The proposed standard will more adequately meet industry's needs for measuring the gloss of higher finish papers.

The present suggested method was first presented to the committee in September, 1948 and has undergone several revisions since that time. The latest revised copy was reviewed and a number of worth-while suggestions in wording were made but in the main the method was acceptable. After incorporating the recent suggestions it was recommended that the method be submitted to the Tappi Standards Committee for publication.

2. Calibration of Fadometers.

The chairman gave a general report on the work that had been done by the National Bureau of Standards on the construction of a master fadometer and on the light sensitive papers for use in calibrating other fadometers with the master machine.

For the past several years the National Bureau of Standards and the American Association of Textile Colorists & Chemists (A.A.T.C.C.) have been developing a method for standardizing and calibrating fadometers and fading exposures given to dyed textiles in determining their color-fastness to light. The Optical Properties Committee of TAPPI have been in close contact with this work and have followed it with interest believing that it would apply to the paper industry as well as the textile industry.

The work at the Bureau of Standards progressed in two stages: (1) The development of a standard fadometer and (2) the development of standard fugitive dyed papers. A description of the "master lamp" and the earlier dyed papers was presented by Dr. H. F. Launer at the Optical Properties Session of the annual TAPPI meeting in New York, Feb. 25, 1946.

The research work leading to the production of Paper No. 1554 including a description of the master lamp will be found in "Light-Sensitive Papers as Controls for Testing Textile Color-fastness and Stability of Materials under Arc Lamp Exposures" by H. F. Launer, Journal of Research of the National Bureau of Standards, vol. 41, September, 1948, Research Paper RP1916.

Directions for Use of the Light-Sensitive Paper No. 1554 are given in a National Bureau of Standards Circular Letter LC934, Jan. 13, 1949.

The Bureau of Standards will supply a quantity of these light-sensitive papers and a booklet containing strips which have been faded by their master fadometer for definite periods of time as 16, 20, 24, 28, 32 hours.

The procedure would be to place in the fadometer an unfaded specimen of the light-sensitive paper and the samples of paper, textile, or other material to be tested. At the end of say 20 hours exposure, the faded area of the test specimen would be compared with the standard strips. The number of "Standard Fading Hours" of exposure is determined by this comparison.

In 1949, TAPPI sent out a questionnaire to 200 pulp and paper mills and replies were received from 75. The largest percentage of replies indicated that a fading time of from 1–8 hours was sufficient, although some mills implied that longer fading times were used.

Since the Bureau's standard faded specimens start at 16 hours, it was suggested that for shorter fading times, the reflectance of faded samples could be made by some type of reflectance meter such as GERS, GERM or similar device and the "Standard Fading Hours" of exposure determined from a calibration curve.

The Optical Properties Committee members have been kept informed of these developments and in preparation for this meeting were asked to submit any data relating to the investigation. Preliminary reports were received from the Institute of Paper Chemistry, Appleton, Wis. and the Hammermill Paper Co., Erie, Pa.

Both laboratories presented spectrophotometric curves of the NBS standard faded specimens. The National Bureau of Standards had supplied a "calibration" curve in which Reflectance measured by the Hunter Multipurpose Reflectometer using the amber filter was plotted against Time of Exposure, Standard Fading Hours. By trial and error it was found that if the reflectance at 540 mmu obtained from the spectrophotometric curves were plotted on the NBS curve close agreement was obtained.

Using the same procedure the reflectance values of light-sensitive papers faded in the two laboratories' fadometers were plotted on the "calibration" curve. This curve showed that these fadometers not only were not in agreement with each other or the NBS master meter, but one was not consistent with itself from day to day operation.

Data were also presented showing how the General Electric Reflectance Meter (Brightness Meter) could be used to calibrate fadometers against the NBS master.

More information is needed from laboratories using fadometers and the chairman requests that such information be forwarded to him so that the committee may have the benefit of all available data. It would be premature and probably misinformative to publish data and curves at this time.

3. Definitions of Color Terms.

The Inter-Society Color Council, in which TAPPI is a member and is represented by the Optical Properties Committee, has recently formed a new committee on Definitions of Color Terms with R. S. Hunter as its chairman.

In January, 1949 the I.S.C.C. published a "Comparative List of Color Terms" report, which culminated the work from 1946–1948 of a Committee headed by Dr. S. M. Newhall. The Optical Society of America is preparing a Colorimetry Report by a committee which has Dr. D. L. MacAdam as its chairman. Both Dr. Newhall and Dr. MacAdam (members of the Kodak Research Laboratories) as well as Mr. Hunter were present and each gave a very clear resumé of their committee activities, and the correlation of I.S.C.C. activities with member societies.

The Colorimetry Report will soon be published in book form and will give a comprehensive review of color and colorimetry. It should have appeal to all interested in color—layman, scientist, industrialist, artist.

The I.S.C.C. Comparative List of Color Terms contains some 1550 currently used color terms and definitions as reported by the 14 societies comprising the membership at

that time and the Color Group of the Physical Society (London). (There are at least 20 member societies today.) The Color Terms report not only lists the meaning of the color terms for a given society but also shows what societies have identical definitions, and what societies have similar definitions on which a basis for developing agreement might be reached. On the other hand some societies have quite different usages for a given term from another society and again some societies use a different term or terms with a meaning similar to another society. Hence there is special need to guard against indiscriminate use of a given term and confusion can result unless all parties are "talking the same language."

As a specific illustration consider the term "brightness." The Color Terms report lists seven definitions of brightness. In six of these the meaning is similar in two or more societies but TAPPI's definition of brightness differs from all other societies. Other examples of like nature can be found in the list and it is the function of the new committee to study these dissimilarities and endeavor as far as possible to effect some better agreement. The aims and purposes as set forth in the constitution of the Inter-Society Color Council clearly defines the council's position in work of this kind.

"The aims and purposes are to stimulate and coordinate the work being done by the various societies, organizations, and associations leading to the standardization, description, and specification of color, and to promote the practical application of these results to the color problems arising in science, art and industry."

A. H. Croup, *Chairman*
Optical Properties Committee

Packaging Materials Testing Committee

Four sessions of the committee were held on three days at Rochester with eleven members of the nineteen-man committee present. The total attendance ranged from fifteen to thirty. The main subjects were Project No. 277, "Water Vapor Permeability at Zero F."; Project No. 328, "Flavor and Odor Transfer"; and Project No. 357, "Water Vapor Permeability of Completed Packages." A considerable amount of time was spent on the assigned projects, particularly water vapor permeability and on suggested new procedures, including testing of adhesives. The present objective is to have at least four new suggested procedures ready for publication by Jan. 1, 1951, and to revise five existing methods.

A. Project No. 277—Water Vapor Permeability at 0°F.

The results of a second series of tests were presented, with nine laboratories participating. The results were not too good, with failure of wax seals. The first problem is to find a satisfactory wax, of several suggested. The over-all objective is to revise the present procedure and to have at least one more round robin test available before the February meeting. Several additional laboratories indicated their willingness to participate in this testing.

B. Project No. 328—Flavor and Odor Transfer

Report by subcommittee, Arthur Landrock, chairman.

Two possible methods were discussed, the first using a human test panel, and the second an analytical method developed by the General Foods Corp. The first procedure was presented to the committee by Fred Cherepow at the Pittsburgh meeting in 1948. The method requires two glass compartments with film being tested sealed between them, with odor source on one side and human nose on the other. The procedure was accepted by the committee as ready for publication as a suggested method.

The second method discussed was the objective procedure as suggested and used by General Foods Corp., using methyl furoate as the organic material penetrating the film to be

Packaging Materials Testing Committee, L. E. Simerl, at left

tested. It was agreed that several laboratories who have spectrophotometers available, and who are interested, will participate in a round robin testing program to be set up. It was agreed that this method would also be placed on the suggested method procedure, as an alternate to the subjective or test panel method. This suggested test procedure should be ready within sixty days.

C. Project No. 357—Water Vapor Permeability of Complete Packages

Report by subcommittee, Robert Couch, chairman.

The committee presented two methods, one water vapor permeability of packages containing calcium chloride, and the other on packages containing a product. Several suggestions were developed during the discussion period, and the procedures as drafted will be revised and a round robin testing system set up for the procedure of water vapor permeability of packages containing calcium chloride. It is anticipated that the suggested procedures will be ready for publication within a few months.

D. Project No. 330—Testing of Pressure Sensitive Tapes

This procedure was discussed at some length at the Pittsburgh meeting in 1948, and a suggested procedure was presented based on Army-Navy Specification JAN-P-127. As a result of a poll of the committee members present, and of the 30 total attending this session, it was determined that there was no particular interest in this procedure in this TAPPI group. As a result, it was concluded that this project would be dropped, and that any interested personnel would be referred to the appropriate federal specification. On the other hand, if it is desired to round out the TAPPI coverage of this subject, it will be very simple to rewrite the JAN specification to fit the TAPPI requirements.

E. Other Assigned Projects

Project No. 275, "Flexibility at Low Temperatures," and Project No. 331, "Heat Sealability," were discussed briefly. The priority of these two procedures, particularly with increased emphasis on low temperature work, is very high. The scope of both is very great, including coating materials, tapes, adhesives, laminated products, and waxes. In view of the interest of the newly formed wax committees in the subject, and in view of the importance of wax to the total picture, it was agreed that cooperative work between the two committees was indicated.

F. Assigned Test Methods

This includes T 446, 448, 463, 464, 465, 473, 474, 475, 476, 477, and 806.

The main emphasis was placed on T 448, T 464, and T 465, dealing with water vapor permeability of paper at the two standard conditions and with creasing of paper for these tests. The wide variation in results obtained by laboratories using T 464 was emphasized by the results on five samples of material used in the round robin for zero F. water vapor

permeability. The procedures were discussed in detail, and agreement was reached on several points which should eliminate major sources of variation. A special subcommittee will be set up to revise these three related procedures, with a target date of Jan. 1, 1951. It was decided that in order to obtain as broad as possible representation, that all those interested in this procedure would be invited to participate by means of an announcement to be published in TAPPI.

T 473, "Insect Resistance of Packages, Paper and Paperboard," was reviewed. There is apparently a need for the revision of the procedure as written, and a separate subcommittee will be set up to handle this specific project. Additional personnel will be invited to assist.

T 476, "Abrasion Loss of Paper and Paperboard," will be revised based on change of grade of the abrading wheel by the manufacturer.

T 477, "Blocking Resistance of Paper and Flexible Materials," is another procedure which is closely allied to the interests of the wax testing committee. Any action taken to revise this procedure will be coordinated between the two committees.

G. Possible New Procedures

There is apparently a demand for standardized procedures within TAPPI for adhesives used throughout the paper and paperboard industry. The discussion brought out that there was a great deal of dissatisfaction with the present basis for buying adhesives, and that a more scientific basis would be welcomed. It is believed that certain of the basic procedures which are now used by adhesive companies and consumers can be written up, to the mutual advantage of the supplier and user. The question of jurisdiction of this committee over this particular subject will be raised, and if the answer is favorable, then the problem will be attacked by a special group.

H. Organization

It has been felt for some time that the present nineteen-man committee has been too unwieldly for some purposes, and that the scope of activities are such that an even broader representation probably is necessary. In order to expedite action, special subcommittees consisting of from one to three men will be set up, each responsible for a given project or assigned test procedures. These men will be picked for their interest in the field, past experience, and willingness to obtain results in a hurry.

L. E. Simerl, *Chairman*
Packaging Materials Testing Committee

Paper Testing Committee

The first session of the Paper Testing Committee was devoted to slight changes in existing specifications and reviewing those specifications which are subject to the periodic examination.

During the second day of the meeting the major part of the session was devoted to the proposed revision of the bursting strength test including certain slight changes in the structure of the Mullen tester. The Canadian Technical Section have also decided on using the same procedure and have carried out the basic investigation which is necessary in order to incorporate the changes. Specifically, the changes are the design of the plates and a different type of gage. These changes can be readily accomplished right in the laboratory, and the tester need not be returned to the manufacturer to make it comply with the proposed method.

The method will be published after a few minor changes are made; the changes were a result of the discussion by those attending the session.

Other methods suggested for the Committee's consideration dealt with pinholes in paper and blood resistance of paper.

A. Kenneth Warner, *Chairman*
Paper Testing Committee

TAPPI-A.S.T.M. Technical Committee on Petroleum Wax

Report on Section V-A, Composition Melting Point and Oil Content

J. B. Rather, Jr., *Chairman* and H. E. Corbin, *Acting Secretary*

Section V-A, Composition-Melting Point and Oil Content, of the TAPPI-A.S.T.M. Technical Committee on Petroleum Wax, met on Sept. 13, 1950, at Rochester, N. Y. Approximately one hundred persons were present. A list of the members of Section V-A, or their representatives, who were at the meeting, is attached. The following business was transacted.

A. M. Heald, Joint Committee Chairman, stated that it was the responsibility of the various sections to initiate work programs and that the chairman should develop and find new or improved methods of tests for submission to the parent committee for approval as a standard method of test. The various sections should consider past, present, and future work in the various fields of wax testing.

Mr. Rather noted that there were no consumers on Section V-A, and issued an invitation to any who wished to participate in the work to write to him requesting membership on the Section.

With respect to the position of A.S.T.M. Committee D-2 in relation to the wax testing work being done by the Joint Committee, the Chairman stated that Subcommittee III on Paraffin Wax, and Section E on Wax Products of R. D. VII on Flow Properties, would continue to function under Committee D-2 for the present. At a later date, however, when the Joint Committee is functioning in all respects, it is probable that the aforementioned two A.S.T.M. Committees can be discontinued in favor of centralizing all wax testing in the TAPPI-A.S.T.M. Joint Committee.

Discussion of Oil Content Methods for Paraffin Wax

The Chairman advised that Method D721-49T, as it now appears in the D-2 Book, is satisfactory except for a few minor changes. In that connection he distributed to the members of Section V-A a new draft of the method dated Aug. 1, 1950 incorporating the several revisions that appear desirable. These changes concern (a) a ground glass apparatus for the filter stick and assembly, (b) a new thermometer calibrated to ± 0.5°F. instead of ± 2°F., (c) a stipulation that the bath temperature be maintained at -28 ± 2°F. instead of -30 to -35°F., and (d) a precaution to standardize the thermometer frequently. The members of the section were requested to furnish written comments covering suggestions or improvements of the Aug. 1, 1950 draft just mentioned.

In order to obtain a cross section of opinion with respect to Method D721-49T versus D721-47, the Chairman asked the following questions and received the answers indicated:

Question	*No. of Answers*
How many are now using D721-49T?	16
How many are not using D721-49T because, in their opinion, D721-47 is better suited to their purpose?	4
How many would like to continue D721-47 as an A.S.T.M. method for at least one year before it is replaced by D721-49T?	10
How many would like to continue D721-47 as an A.S.T.M. method for at least two years before it is replaced by D721-49T?	8

In discussing D721-49T two representatives stated that they had experienced some difficulty in determining oil contents below 0.3/0.5% where nontechnical operators were involved. It was pointed out, however, that if well-adjusted analytical balances were used, there should be no difficulty in that respect. One of the representatives stated that some of the laboratories in his organization felt that D721-47 is better than D721-49T for control purposes because it is less

TAPPI-A.S.T.M. Technical Committee on Petroleum Wax meeting, A. M. Heald, Jr., Chairman, second from left

dependent upon the use of skilled operators. He agreed, however, to look into the matter again since this point of view does not check majority opinion.

Discussion of Oil Content Methods for Microcrystalline Wax

For the benefit of the group, the Chairman reviewed A.S.T.M. D-2's activities for the last few years on the determination of oil content of microcrystalline wax:

In 1945, A.S.T.M. D-2's Subcommittee III on Paraffin Wax, began investigating methods for the determination of oil content of microcrystalline wax. Four methods, all of them solvent methods which differed in regard to the solvent, solvent concentration, and temperature, were tested. These methods were those used by the following companies:

1. Standard Oil Company of California
2. Mid-Continent Petroleum Corporation
3. Socony-Vacuum Oil Company
4. Standard Oil Company of New Jersey

The subgroup reported after investigation that methods 3 and 4 seemed more promising than 1 and 2.

Early in 1946, the semimicro version of A.S.T.M. D721-47 appeared and showed so much promise that work using the macro technique was dropped in favor of this new method. Test work was done on microcrystalline and on blended waxes using the semimicro version of method 3, (Socony-Vacuum ethylene dichloride procedure). It was realized by the committee members that adoption of two methods, one for paraffin and one for microcrystalline waxes had the objection that if the sample were a blended or an unknown, the test to be applied would be questionable. It was shown by Mid-Continent that the oil content of blends could not be calculated in advance unless the same method were used for both components.

Accordingly, an attempt was made to adapt the methyl ethyl ketone procedure for paraffin to microcrystalline waxes so that the same method could be applied equally well to paraffin, microcrystalline, and blended waxes. This idea had been suggested before when the macro technique was employed but had not found favor because of the difficulty in dissolving microcrystalline waxes in methyl ethyl ketone. On the semimicro scale however, it met with greater success. Only the high melting microcrystalline waxes failed to give uniform test results. This year additional samples were circulated. Four very high melting point microcrystalline waxes are currently being tested using the MEK procedure (now A.S.T.M. D721-49T) with a stirring modification. Preliminary results are given in the Chairman's letter of Sept. 8, 1950. From the preliminary results it appears that this modified method will be applicable to all petroleum waxes and will show good reproducibility even on high melting waxes.

The group discussed in considerable detail the need for a method for oil content of microcrystalline wax. Although some members of the paper industry did not have positive opinions on the subject, it was generally concluded that oil content methods for both paraffin and microcrystalline waxes are necessary for determining performance properties with greater accuracy. It further was agreed that a single solvent method appear to be the logical approach to the problem even though results would be somewhat arbitrary. Largely on the basis of information presented by the Phillips Petroleum Co., the group decided to institute an investigation of methyl iso-butyl ketone in place of methyl ethyl ketone as a solvent. It was agreed that all other conditions given in Method D721-49T would remain the same. The decision to investigate MIBK was based largely on the fact that it is a somewhat better solvent for microcrystalline wax and, furthermore, it is claimed that results on paraffin wax closely agree with those obtained using MEK. The Chairman agreed to circularize the following six samples of wax for a round-robin series of tests using MIBK:

1. A low melting point paraffin wax of about 0.25% oil content.
2. A high melting point paraffin wax of about 0.25% oil content.
3. A paraffin wax of about 3.5% oil content.

4 and 5. Two high melting point microcrystalline waxes.

6. A blend of one of the microcrystalline waxes and one of the 0.25% paraffin waxes.

It was recommended that all of the members try MIBK on various other waxes, both microcrystalline and paraffin, in which they are interested.

Discussion of Melting Point Methods for Microcrystalline Wax

The Chairman reviewed for the committee work done by A.S.T.M. Committee D-2 on melting point of microcrystalline waxes:

In late 1945 Subcommittee III investigated several methods for the determination of the melting point of petrolatum. Two samples of microcrystalline wax were included. At that time A.S.T.M. D127-30 was in common use for melting point of microcrystalline wax although there was no reference in the method to such application. It was common experience that cooling curve methods, such as D87-42 for paraffin wax, showed no clear inflection point which could be defined as the melting point when microcrystalline waxes were tested. Five methods were tested by cooperative survey:

D127-30 ("Drop" Melting Point)
D566-42 (Dropping Point of Lubricating Grease)
IP 76/44 (Congealing Point)
Pour Point
Wire Coil

It was found, as might be expected, that D127-30 gave the highest result (with just one minor exception) and that the deviations from D127-30 varied widely depending upon the nature of the samples. The low melting petrolatum with high oil content (having the widest melting range) showed the greatest deviation.

The committee felt that since D127-30 was being used satisfactorily as a specification test, it should be retained. It was agreed that an additional method (IP 76/44 now D938-49, Congealing Point of Pharmaceutical Petrolatums) should be standardized in order to satisfy Subcommittee I on Pharmaceutical Tests who apparently wanted a test to indicate "the temperature at which the material will first become fluid." Accordingly, the method was written and a thermometer standardized. Cooperative testing of the method indicated excellent precision. It was issued as tentative in 1947 for use on petrolatum and became standard in 1949.

Method D127-30 was revised to include microcrystalline wax within its scope and new thermometer with a wider range was standardized. Cooperative testing in 1949 indicated good precision except on microcrystalline-paraffin blends. The extension of the scope of D127 was inserted into the method and appears now in the 1949 D-2 Manual as the standard test for melting point of microcrystalline wax.

The Chairman also called to the attention of the group an article entitled "Comparison of Melting Point Methods for Wax" in Vol. 22, No. 6, June 1950 of Analytical Chemistry. This reviews various procedures and is worth-while reading

The discussion brought forth an agreement to the effect that D127-49 does not meet the needs of the paper industry in that it does not show when the wax really becomes fluid in commercial use. It is particularly deficient where blended waxes are involved. The Chairman stated that Section V-A would welcome any suggestions as to improved procedures for melting point which might be made the subject of a cooperative study. In response to this request, J. W. Padgett of Moore and Munger stated that they have been using a cooling curve determination for years for melting point of paraffin and microcrystalline waxes. He offered to submit this method to Section V-A for consideration. When the Moore and Munger procedure is received, Section V-A will decide what action is to be taken in respect to investigating its merits.

Those present included: R. J. Askevold, Pure Oil Co.; W. N. Axe, Phillips Oil Co.; V. A. Denslow (T. E. DeVillers), Cities Service Oil Co.; N. J. Gothard, Sinclair Refining Co.; W. T. Harvey (G. E. Reese), Sun Oil Co.; M. A. Joanen, Sinclair Refining Co.; G. Kaufman (R. J. Harrington), The Texas Co.; W. E. Scoville, Standard Oil Co. of Ohio; A. C. Smith, Jr. (H. M. Hancock), The Atlantic Refining Co.; W. L. Thompson, Mid-Continent Oil Co.; V. J. Tkac, Tide Water Oil Co. and J. B. Rather, Socony-Vacuum Oil Co., Inc.

A. M. Heald, *Chairman*
TAPPI-A.S.T.M. *Technical Committee on Petroleum Wax.*

Container Testing Committee

Although the Container Testing Committee did not meet at Rochester, it has met separately at other times. Following is a report of its current status:

In 1949 the membership of the committee was increased from five (5) to fourteen (14) or more with additional members now requesting active participation.

This is we believe consistent with a policy that attempts to have a fair representation of all phases of activity in TAPPI membership.

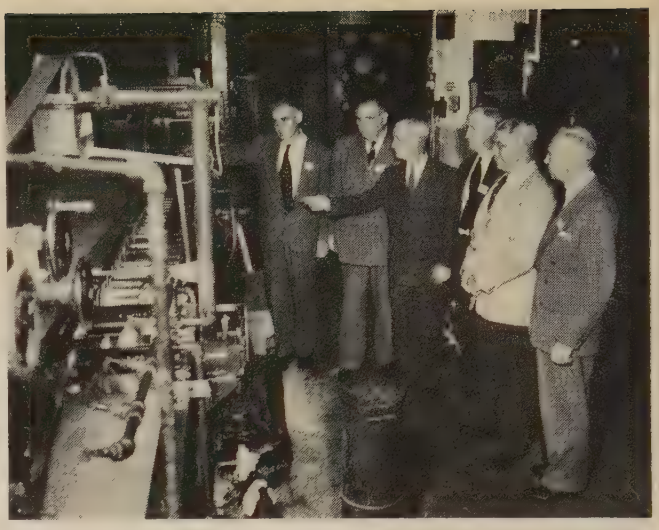
The committee works closely with A.S.T.M. in attempting to bring about a mutually agreeable set of standards. In fact, members of the Container Testing Committee are also members of A.S.T.M. committees. The status of the various methods at the present time are:

T 800 SM-44—Drum Test. Advanced to Tentative, February, 1950.
T 801 SM-44—Conbur Test. Being rewritten by subcommittee.
T 802 M-44 —Drop Test. This method is at present in process of discussion through correspondence.
T 803 M-44 —Puncture Test. A revision of this method is being voted on by A.S.T.M. Further action awaits that society's findings.
T 804 M-45 —Compression Test. This could be advanced to Official. There are several points now being considered such as fixed vs. moving platen, etc. which will be resolved in the near future.
T 805 SM-45—Shower Test. At present this is a suggested method. It could possibly be advanced to Tentative.

The Mullen or Cady bursting standards as adopted by the carriers has been in process of standardizing for years. At the present time it is being processed as a TAPPI standard.

Procedures to be considered for action are as follows:

1. Vibrator test.
2. Strip score test.
3. Flat crush test.
4. Scuff test.
5. Compression.
6. Adhesion test for solid fiber and corrugated, at high humidities, and/or immersion.
7. Standardization of immersion number or equivalent.
8. Standardization of wet Mullen.
9. Water resistance test



G. T. Lane, Asst. Manager, Kodak Park Works points out features of paper machine of Eastman Kodak Co. to J. d'A. Clark, A. E. Bachmann, R. G. Macdonald, Milton Fillius, and K. P. Geohegan at the TAPPI Testing Conference at Rochester

In view of existing unstabilized world conditions today it is going to be quite difficult to carry on the committee activities. However, this unstable condition in itself is an incentive to establish as quickly as possible standard methods of testing acceptable to all concerned.

W. J. Balster, *Chairman*
F. D. Long, *Secretary*
Container Testing Committee

Coating Committee

The Coating Committee held a meeting at the Association headquarters September 29 at which it accepted an invitation from the New England Section to hold a conference in Boston next spring. The Second Coating Conference will be held at the Hotel Statler in Boston, April 18–20, 1951 with A. D. Bonanno of the Champion-International Co. of Lawrence, Mass. as General Chairman.

Fourteen members of the committee were present and with J. H. Heuer of the St. Regis Paper Co., Chairman of the Coating Committee, they discussed the program to be presented. The theme decided upon was "Coating Raw Stock" and authorities in the various fields will be invited to discuss their particular interests. The subjects will include raw stock for wallpaper, board, book, magazine, and specialties taking into consideration the various methods of coating application. This section of the program will be developed by R. T. Trelfa, Hercules Powder Co., Chairman of the Raw Stock Subcommittee.

The general session will be devoted to subjects of general interest with the primary interest centered on printing requirements of coated papers.

Because Boston is one of the printing centers in the country, it was suggested that those who will attend would probably be interested in visiting one of the outstanding printers and thus obtain a better knowledge of the processing of their products. Consequently, the Committee will attempt to make arrangements for visits that will be of special interest to all coaters.

The committee also discussed its publication program. It now has two monographs at the press, "Machinery for Paper Coating" and "Protein and Other Adhesives for Paper Coating" which will be published this fall. It is expected that 1951 will see further efforts of the committee in the form of monographs on testing, gummed products, waxed papers, and possibly on raw stock.

PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

Leonard S. Barnes, Design Engineer, The Gardner Board & Carton Co., Middletown, Ohio, a 1945 graduate of Illinois Institute of Technology.

Edward D. Beachler, Chief Engineer, Beloit Iron Works, Beloit, Wis., a 1935 graduate of the University of Nebraska.

Anthony J. Bellucci, Assistant Chemist, Robert Gair Co., Piermont, N. Y., a 1943 graduate of New York State College of Forestry.

J. Shartle Brookover, General Superintendent, Lockland Board Mill, The Gardner Board & Carton Co., Cincinnati, Ohio, a 1927 graduate of Lehigh University.

James S. Brown, Paper Mill Superintendent, Marinette Paper Co., S. Glen Falls, N. Y., a 1941 graduate of Drexel Institute of Technology.

Viktor Bunzl, Assistant Manager, Paper Mill, Bunzl & Biach A. G. Papierfabrik Ortmann, Ortmann, N. Oe., Austria, a 1942 graduate of London University.

Fredrik Cappelen, Managing Director, Aktiebolaget Molnbacka-Trysil, Forshaga, Sweden, a 1914 graduate of University of Technology, Trondheim.

Joseph D. Clemens, Master Mechanic, Central Paper Co., Muskegon, Mich., a 1939 graduate of Michigan College of Mining and Technology, with an M.S. degree from Purdue University in 1940.

Sanford L. Cluett, Vice-President, Cluett, Peabody & Co., Inc., Troy, N. Y., a 1898 graduate of Rensselaer Polytechnic Institute.

C. Duane Coates, Student, New York State College of Forestry, Syracuse, N. Y.

Robert M. Cook, Chief Engineer, Midwest-Fulton Machine Co., Dayton, Ohio, a 1933 graduate of the University of Cincinnati.

Alex Coutras, Student, New York State College of Forestry Syracuse, N. Y.

Donald W. Curtis, Staff Engineer, Beloit Iron Works, Beloit, Wis., a 1938 graduate of Johns Hopkins University.

Francis J. Early, Student, New York State College of Forestry, Syracuse, N. Y.

Harry P. Eichin, Division Engineer, The Visking Corp., North Little Rock, Ark., a 1928 graduate of Illinois Institute of Technology.

Fred R. Erbach, Sales Engineer, Beloit Iron Works, Beloit, Wis., a 1922 graduate of the University of Wisconsin.

Robert B. Foulis, Retired. A 1906 graduate of Heriot Watt College, Edinburgh, Scotland.

William O. Gutzwiller, Research Chemist, Howard Paper Mills, Inc., Dayton, Ohio, a 1950 graduate of the University of Cincinnati.

Charles F. Hill, Jr., Chemist, The Sorg Paper Co., Middletown, Ohio, a 1948 graduate of Ohio State University.

Gilman D. Horn, Night Foreman, Groundwood Mill, International Paper Co., Chisholm, Me., a 1942 graduate of the University of Maine.

William F. Hughes, Project Engineer, J. E. Sirrine Co., Greenville, S. C., a 1930 graduate of Clemson College.

Dwight E. Jones, Vice-President in Charge of Engineering and Manufacturing, E. D. Jones & Sons Company, Pittsfield, Mass., a 1928 graduate of Worcester Polytechnic Institute.

Krishna K. Khandelwal, Graduate Student, Pulp and Paper Dept., University of Maine, Orono, Me., a 1950 graduate of the State University of Iowa.

Elliot S. Kohn, Mechanical Engineer, Rowland Tompkins & Son, Inc., New York, N. Y., a 1947 graduate of Cooper Union School of Engineering.

Gilbert E. Kohr, Assistant Director of Engineering, Export Dept., Shartle Bros. Machine Co., Middletown, Ohio.

Menachem Lewin, Principal Research Officer, Research Council of Israel, Hakirja, Israel, a 1944 graduate of the Hebrew University, Jerusalem.

O. Gunnar Lindqvist, Engineer in Charge of Cellulose Dept., Cia. Celulosa Argentina S. A., Buenos Aires, Argentina, a 1932 graduate of National College and Electrotechnical School.

James Loughman, Chief Engineer and Production Manager, Falls Paper & Power Co., Oconto Falls, Wis., a 1933 graduate of Massachusetts Institute of Technology.

Paul Lund, Director, Munkedal Paper Mill, Munkedal, Sweden, a 1916 graduate of Orebro Technical Institute.

Sten Th. Lundberg, Managing Director, A. B. Brusafors-Hallefors & A. B. Svenskt Papper, Silverdalen, Sweden, a 1925 graduate of Chalmers Technical University, Gothenberg.

Robert J. Lurvey, Chemical Engineer, Johns-Manville, Manville, N. J., a 1947 graduate of the University of Maine.

Edward A. Mason, Director, Massachusetts Institute of Technology Station, Eastern Corp., Bangor, Me. a 1945 graduate of the University of Rochester, with an Sc.D. degree from the Massachusetts Institute of Technology in 1950.

John H. McMillan, Chemist, Westminster Paper Co. Ltd., New Westminster, B. C., Canada, a 1950 graduate of the University of British Columbia.

Hisanori Mori, President, Hokkai Paper Mfg. Co., Ltd., Chiyoda ku, Tokyo, Japan, a 1917 graduate of Keio University.

Donald C. Morris, Plant Engineer, Armstrong Cork Co., Pensacola, Fla., a 1942 graduate of the University of Iowa.

Yuji Nakagome, Chief, Pulp Section, Kitanihon Seishi Co., Hokkaido, Japan, a 1925 graduate of the Higher Technical College.

Alonzo A. Neese, Assistant Chief Engineer, Beloit Iron Works, Beloit, Wis., a 1943 graduate of Purdue University.

Merrill J. Osborne, Electrical Engineer, Crossett Paper Mills, Crossett, Ark., a 1944 graduate of Georgia School of Technology.

Ernest R. Passow, Technical Control Supervisor, Nekoosa Mill, Nekoosa-Edwards Paper Co., Port Edwards, Wis., a 1942 graduate of Purdue University.

Herloff B. Petersen, Technical Service Engineer, Hercules Powder Co., Portland, Ore., a 1939 graduate of Iowa State College.

Robert E. Phinney, Plant Manager, Container Corp. of America, Fernandina, Fla., a 1930 graduate of the University of Cincinnati.

Mario L. Pineiro, Staff Engineer, Papelera Rio Parana S. A., Buenos Aires, Argentina, a 1945 graduate of Universidad de Buenos Aires.

Charles R. Puliafico, Treasurer, Fleetwood Chemical Co., Inc., Webster, Mass., a 1944 graduate of Lowell Textile Institute.

F. Dewart Robinson, Jr., Student, New York State College of Forestry, Syracuse, N. Y.

James H. Ross, Consultant, Donald, Ross & Co., Montreal, P. Q., Canada, a 1920 graduate of McGill University, with an Sc.D. degree from the University of Geneva in 1922.

Takashi Saito, Vice-President, North Japan Paper Mfg.

Co., Ltd., Chuo-ku, Tokyo, Japan, a 1928 graduate of Tohoku University.

Paul J. Schmitt, Chemical Engineer, P. H. Glatfelter Co., Spring Grove, Pa., a 1949 graduate of Lehigh University.

Leon E. Semke, Development Chemist, Crown Zellerbach Corp., Camas, Wash., a 1931 graduate of the University of Oregon.

Oliver M. Thomsen, Sales Manager, Wisconsin Container Corp., Menasha, Wis. Attended Carroll College.

Pentti M. Toppari, Assistant Chief Chemist, Rayonier, Inc., Hoquiam, Wash., a 1937 graduate of the State College of Washington.

Pedro Vicien, Staff Engineer, Papelera Rio Parana S. A., Buenos Aires, Argentina, a 1945 graduate of Massachusetts Institute of Technology with an S. M. degree.

Roy R. Wiberg, Shift Chemist Weyerhaeuser Timber Co., Longview, Wash., a 1950 graduate of the University of Wisconsin.

Czeslaw J. Witkowski, Sales Engineer, Export Dept., Shartle Bros. Machine Co., Middletown, Ohio, a 1927 graduate of Gimnazium, Warsaw, Poland; a 1934 graduate of Warsaw Technical College, Poland; a 1942 graduate of the University of Grenoble with an M.S. degree.

Ralph G. Young, Jr., Plant Engineer, Marinette Paper Co., Glens Falls, N. Y., a 1942 graduate of Drexel Institute of Technology.

Robert N. Zabe, Research Dept., Oxford Paper Co., Rumford Me., a 1950 graduate of the University of Maine.

TAPPI Notes

Arnold H. Anderson is now National Planning Coordinator for the Individual Drinking Cup Co., Easton, Pa.

Carl A. Anderson is now Process Control Supervisor for the Brown Co., Berlin, N. H.

Donald H. Baker, formerly with H. A. Simons, is now Technical Director, Pulp Division, H. R. MacMillan Export Co., Nanaimo, B. C.

E. W. Bartholow, Jr., Chemist for the Riegel Paper Corp., has been transferred to the Riegel Carolina Corp., at Acme, N. C.

Carl B. Bennett, formerly of the Catalin Corp. of America is now a Development Engineer for the Rohm & Haas Co., Philadelphia, Pa.

LeRoy A. Blaisdell, formerly of the Kelco Co., is now Technical Sales Representative for the Chemical Division of the Marathon Corp., New York, N. Y.

Richard W. Brown, formerly student at the Institute of Paper Chemistry is now Chemist for the Hammermill Paper Co., Erie, Pa.

Thomas S. Chambers, formerly of the A. B. Dick Co., is now Chemical Consultant, 3017 E. 78th St., Chicago 49, Ill.

George B. Creamer is now Research Chemist for Rayonier, Inc., Shelton, Wash.

Lovell M. Cushing is now Manager of the Pulp Division, Brown Co., Berlin, N. H.

Edwin C. Daniels, Chemist for Texon, Inc., has been transferred from South Hadley Falls, Mass., to Hungtington, Mass.

Eugene De Luca, formerly of the Fraser Co., Ltd., is now in charge of technical service and process development for G. D. Jenssen Co., Inc., Watertown, N. Y.

Daniel S. Dieffenderfer is now Laboratory Manager, Individual Drinking Cup Co., Easton, Pa.

John O. Edwards, formerly of the University of Wisconsin, is now in the Chemical Department, Cornell University, Ithaca, N. Y.

Gilbert Godin, formerly student of the N. Y. State College of Forestry is now Research Engineer, Johns-Manville Research Center, Finderne, N. J.

Russell C. Grimshaw, formerly student of the N. Y. State College of Forestry is now Paper Supervisor, Individual Drinking Cup Co., Easton, Pa.

Martin H. Gurley, Jr., formerly of the American Textile Co., is now Consultant, P. O. Box 637, Pawtucket, R. I.

Walter G. Hendrich is now Processing Superintendent, Hammermill Paper Co., Erie, Pa.

Elliott G. Heslop, formerly of Provincial Paper, Ltd., is now Superintendent, Abitibi Power & Paper Co., Sturgeon Falls, Ont.

John H. Heuer, formerly of the St. Regis Paper Co., is now Manager of the A.P.W. Products Co., Inc., Albany, N. Y.

Allan C. Hill is now First Vice-President of the Montmorency Paper Co., Inc., New York, N. Y.

George B. Hills, Jr., formerly of the St. Joe Paper Co., is now Special Assistant for the Powell River Co., Ltd., Powell River, B. C.

Hugo Klein, formerly of R. C. Reproduction Products is now Plant Manager, Lithoplate, Inc., Los Angeles, Calif.

Sigmund Landsman, formerly of the West Virginia Pulp and Paper Co., is now Pulp and Paper Consultant for Frederick L. Smith, New York, N. Y.

Richard D. Lewis, formerly of the St. Regis Paper Co., is now Chemical Engineer for Finch, Pruyn & Co., Inc., Glens Falls, N. Y.

Frank B. Lincoln, Jr., formerly Physicist with Hollingsworth & Whitney is now with the Time-Life-Fortune Laboratories, Springdale, Conn.

John D. McCrystal, formerly of the Upson Co., is now General Plant Manager for Doeskin Products, Inc., Wheelwright, Mass.

J. Judson Mealy, formerly Asst. Director of the M.I.T. Station, Eastern Corp., Bangor, Me., is now Asst. Plant Superintendent, Royal Lace Paper Works, Inc., Brooklyn, N. Y.

Harry V. Miles, Jr., formerly with the Honan Crane Corp., is now Head, Research and Development, Filtration Division, U. S. Hoffman Machinery Corp., Syracuse, N. Y.

Frank Miller is now Technical Superintendent, Ancram Paper Mills, Ancram, N. Y.

Edward W. Murphy, formerly of Milprint Inc., is now Superintendent of Processing, Kaiser Aluminum & Chemical Co., Permanente, Calif.

Murry L. Oliver is now Asst. Chief Chemist, Hummel-Ross Division, Continental Can Co., Inc., Hopewell, Va.

H. A. Paterson is now Asst. General Superintendent and Control Superintendent, Mersey Paper Co., Ltd., Liverpool, N. S.

Sam H. Popovich, formerly Student, N. Y. State College of Forestry, is now Quality Control Supervisor, W. C. Hamilton & Sons, Miquon, Pa.

Joseph F. Senuta, formerly of English China Clays Co., is now Chemist for the Champion-International Co., Lawrence, Mass.

Eleanor G. Sheridan, formerly of the Bjorksten Research Laboratories is now Research and Development Chemist for the U. S. Finishing & Mfg. Co., Chicago, Ill.

Norton Speck, formerly of the Dixie Cup Co., is now Waste Control Supervisor, Individual Drinking Cup Co., Chicago, Ill.

Harry J. Stilp, formerly of the Inland Wall Paper Co., is now Vice-President and Partner of S & V Engineering Service, Inc., Chicago, Ill.

J. N. Swartz is now Technical Superintendent, Howard Smith Paper Mills, Cornwall, Ont.

Thomas D. Tierney, formerly with A. J. Rauh & Co., is now Piping Engineer, Brown & Root, Inc., Houston, Tex.

Paul E. Trout, formerly Student at the N. Y. State College of Forestry, is now Research Assistant, American Box Board Co., Filer City, Mich.

R. T. Van Derveer, formerly of the NOPCO Chemical Co., is now Paper Control Superintendent, Triangle Publications, Inc., Philadelphia, Pa.

M. H. Vaughan, formerly of the Solvay Process Co., is now Mill Manager, Riegel Carolina Corp., Acme, N. C.

Allan T. Walsh is now Engineer for the Riegel Paper Co., Riegelsville, N. J.

Carl T. Welte is now Asst. General Superintendent of Paper and Board Manufacture, Champion Paper & Fibre Co., Canton, N. C.

William R. Zwecker, formerly of the Saugerties Paper Mills, Inc., is now Consulting Engineer, The Zwecker Co., 421 W. Melrose Ave., Chicago 13, Ill.

* * *

The following companies have become Sustaining Members of the Technical Association:

The Louis Allis Co., Milwaukee, Wis. C. C. Skidmore is the official representative.

The Hauser Stander Tank Co., Cincinnati Ohio. Frank H. Bailey is the official representative.

Tremont Lumber Co., Chicago, Ill. Dudley B. Kean is the official representative.

* * *

Recent visitors to the United States have included: Francois Harmant, Papeteries Steinbach, Malmedy, Belgium, and Atushi Nishizawa, Production Manager, Sanyo Pulp Co., Tokyo, Japan.

Industry Notes

New facilities for the increased production of caustic soda and chlorine at the Tacoma, Wash., plant of the Hooker Electrochemical Company have been completed. The expansion of production facilities consists primarily of the installation of two circuits of the new Type S3 electrolytic cells which have far greater capacity than the old cells replaced. In addition to the new cells, extensive additions have been made for treating and handling brine, for purifying and evaporating caustic soda, and liquifying chlorine. Triple effect pans have been installed for caustic evaporation and a new boiler supplies the additional steam requirements. Other facilities completed include a new cell construction and renewal building, additional storage tanks, enlarged water supply system, expanded dock facilities, and other facilities to handle the increased production.

The additional production of caustic soda and chlorine is largely to meet the increasing requirements of pulp mills in the Pacific Northwest. Other industries served in the West Coast area include petroleum, soap, mining, food, plywood, chemicals and water treatment.

* * *

Frank L. Sullivan has been appointed sales representative in the New York Metropolitan area by the Philadelphia Quartz Co., Philadelphia, Pa.

* * *

The consumption of bituminous coal in the paper industry in 1939 was 9,195,000 net tons. In 1947 it was 13,501,000 tons, a percentage of change of 46.8. In 1947 the food industry used 12,495,000 tons and the textile industry used 5,938,000 tons. The chemical industry used 17,709,000 tons.

* * *

Under NPA Regulation 2 the Secretary of Defense and the Atomic Energy Commission may assign their suppliers of petroleum and foodstuffs, the right to apply DO ratings to acquire containers, packaging, and chemicals which are to be used in packaging or processing petroleum and food.

* * *

The Public Health Service, Federal Security Agency, Washington, D. C., has issued a bulletin (P. H. Service Publication No. 11) entitled "Clean Water in Everybody's Business." Copies may be obtained from the Superintendent of Documents, Government Printing Office at 20 cents per copy.

Robert J. Casey has joined the J. M. Huber Corp., as a technical salesman for coating and filler paper clays. Mr. Casey was assistant coating superintendent at the American Coating Mills, Elkhart, Ind.

* * *

The preliminary report on Paper and Board Production recently released by the U. S. Department of Commerce reveals that 20,330,415 short tons were produced. This is a decrease of about 7% from the 1948 figure.

The production of paper grades at 9,211,447 tons is 6% less than that reported for 1948. However, the production of newsprint continued the upward trend of recent years reaching 927,365 tons in 1949. Production of sanitary grades amounted to 1,005,992 tons, an increase of about 2% over the output of these grades in 1948. In the sanitary grades, the most noteworthy notable gain was registered by toweling stock which reached 267,405 tons, an increase of almost 19% over 1948.

The total production of paperboard amounted to 8,991,425 tons as compared with 9,368,774 tons in 1948, a decline of about 4%.

Construction of paper and board amounted to 2,000,354 tons, a decline of almost 24% from 1948. Building board showed the heaviest decline dropping 34% to 838,729 tons for 1949.

* * *

Julian E. Tobey, President, Appalachian Coals, Inc., Cincinnati, Ohio, and a member of TAPPI has received the 1950 Percy Nicholls Award for notable scientific or industrial achievement in the field of solid fuels. This award, sponsored jointly by the A.S.M.E. and A.I.M.E. was presented on October 24 at the Statler Hotel in Cleveland at a joint meeting of the two societies. The award was made for his work as Chairman of the Technical Advisory Board of Bituminous Coal Research Inc.

* * *

The Minnesota Mining & Mfg. Co., 900 Fauquier St., St. Paul 6, Minn., announces a transparent cellophane tape for splicing paper, "invisibly and permanently." The tape is provided in a 1296 inch roll in widths up to one inch. Distribution is through paper jobbers. Sample rolls are available from the Company.

* * *

John T. M. Frey has been appointed assistant manager of the New York Branch of the Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J.

* * *

Thomas E. Moffitt has been appointed Asst. Works Manager of the Tacoma, Wash., plant of the Hooker Electrochemical Co. From 1945 to the present Mr. Moffitt was employed by the Weyerhaeuser Timber Co., and the Pennsylvania Salt Mfg. Co. John D. Rue is Works Manager of the Tacoma plant which makes chlorine and caustic soda and hardens fish oils, tallow, and other oils through the use of by-product hydrogen.

* * *

R. B. MacMullin and Associates, Consulting Chemical Engineers have opened new offices at 610 Niagara Bldg., Niagara Falls, N. Y.

* * *

The Shartle Brothers Machine Co., Middletown, Ohio, has announced that to date 732 Hydrapulpers have been sold.

* * *

The United States with 6% of the world's population, operate 51.6% of the world's trucks and buses. There are

more than 8,000,000 trucks in the United States. Ten per cent of the trucks are operated by railways.

* * *

The first information about the International Exposition Printing and Paper—called "drupa"—has met with considerable interest. The longing of experts for a comprehensive show demonstrating the capacity of the graphic trade, the paper and pulp working industries, and all kindred trades is a very strong one in all economic branches which are concerned. All competent associations in the Federal Republic have already confirmed their readiness for cooperation and assistance.

This special show of which Federal Minister of Economics, Prof. Dr. Erhard, has accepted the protection, will be held at Dusseldorf. The classification of exhibits will be as follows: (1) Machinery and Accessories, (2) Raw Materials and Auxiliary Means, (3) Graphic Products, (4) Paper and Pulp Working, (5) Advertising Art, and (6) Associations.

As at home, the plans for this "drupa" exposition have already found a great number of highly interested people abroad. This proves that there is also a strong want for the resumption of economic relations and the exchange of experience made during the last decade. Thus, Dr. Freiherr van Maltzan, permanent Secretary of the Federal Ministry, was able to cable from his journey to Brazil that many interested people of that country are already looking forward to the exhibition with high expectations. As this show will have to be prepared very carefully, it will not be opened until Saturday May 26, 1951. The Exposition will close on Sunday, June 10, 1951.

* * *

Oliver United Filters has issued a new bulletin (No. 702) on the Oliver Board Forming Machine.

* * *

Lester C. Higbee has been appointed director of engineering of W. & L. E. Gurley, Troy, N. Y., 105-year-old manufacturers of engineering and surveying instruments. Mr. Higbee, who was recently elected secretary of the company, will continue as sales manager, the position he has held since 1945. He has been with the company since 1915, serving successively as production engineer, office manager, salesman, advertising manager, development engineer, and sales manager. He is a civil engineering graduate of Rensselaer Polytechnic Institute, class of 1912.

Founded in 1845, Gurley is the oldest manufacturer of engineering and surveying instruments in the United States. Its equipment covers the fields of surveying, goedesy, meteorology, paper and tensile testing, and standard weights and measures.

* * *

W. R. Grace and Co., and The Sandy Hill Iron and Brass Works of Hudson Falls, N. Y., are now offering to the trade the exclusive W. R. Grace and Co., formula for the production of paper from sugar-cane bagasse.

W. R. Grace and Co. entered the sugar refining field in 1926 when they began the development of the Casa Grace plantation at Paramonga, a 14,000 acre sugar tract on the coastal plain of Peru. With the acquisition of these sugar interests a long-range program, with emphasis placed on efficiency of operation, high yields, and purity was initiated.

The Sandy Hill Iron and Brass Works, established in 1858 on the Hudson River, began early to specialize in machinery for the pulp and paper field. Today Sandy Hill has papermaking machinery operating in every papermaking state in the United States and in many countries of the world.

It is claimed that before the perfection of the W. R. Grace and Co. formula the profitable production of paper from

W. R. Grace and Co. plant at Paramonga, Peru

sugar-cane bagasse had presented many problems. Now after more than a decade of successful operation, the Paramonga installation has proved a practical and profitable process for producing paper from sugar-cane bagasse.

Many different varieties of paper are produced to meet the growing demand within Peru itself. Multiwall bags from one-ply to six-ply are manufactured in line with the packaging demand of Peru's sugar, cement, lime, quartz, mineral, and flour industries. Colored wrapping papers, both plain and striped, in a variety of weights, finds wide use in department stores and drug stores. A mottled gray paper is especially made for an inside cigarette package wrapper, while a gold paper is used for chocolate candy wrapping. A 40-gram blue paper is produced for cotton packaging. Colored papers of heavier weights find further use in notebook manufacture.

In addition Paramonga turns out heavy liner boards and corrugated boards for the manufacture of cardboard boxes. A heavy board is produced and laminated to form several different types of building board. A thin paper for air mail purpose is one of Paramonga's latest accomplishments.

Fiberboard Plant in South Africa

On October 3, the factory of the Trans-African Paper Products (Pty.) Ltd., at Boksburg (Transvaal), supplied the first lot of suitcase board to a customer in Johannesburg.

The initial capacity of the mill amounts to 100 tons of board per month. The production program will include fiberboard of various qualities to be used by the manufacturers of suitcases, shoes, motorcars, and electrical equipment, by the stationery trade, etc.

The process used is classical. The machines, however, are of the most modern design. Locally collected wastepaper and imported pulp are used as raw materials. They are first of all repulped in a heavy kollergang. The pulp is then passed over a vibrating screen, and dropped into trucks. The trucks are lifted over one of the two Fuellner-type beaters, to be emptied into them by simply opening the bottom. After the required beating, sizing, and dying has taken place, the stock is conveyed into one or both bucket-wheel chests by a high density Egger pump, made under license in the Union of South Africa. The bucket wheels deliver the stock into a launder, in which proper dilution takes place, so that the pulp can be screened through a Lamort strainer, after having passed a simple sand trap.

The board machine was supplied by Maule & Cie., Turin, Italy. It is a two-vat unit with a streamlined inlet, and the sheet is couched off by a felt which passes a suction box before it is rolled on a heavy couch drum until the required number of layers (thickness) is obtained. This is controlled by an automatic device. The large wet boards are taken from the drum by slitting through along the width and pulling them on an adjoining table. Stacks of the wet boards are made, with sheets of cloth in between to prevent them from sticking to-

gether when placed under an 800-ton press, which was also made in the Union of South Africa. After appropriate pressing, the boards have to be dried until air-dry.

After the drying process, the boards are passed through machines to give them the required finish. For glazing and also for calibrating, a heavy Kleinewefer two-bowl calender has been installed. To make suitcase board, a special resistant coating in a variety of colors has to be applied. This is done on a roller-coating machine, connected with an "Infrarot" drying machine, which dries the layer of coating material in a number of seconds. Further there are the necessary machines for embossing, cutting, damping, etc., the greater part of which was supplied by Carcano Gerolamo Bros., Maslianico, Italy. For the finishing of presspan, a typical machine which polishes the board with agate stone has been purchased.

A Sveen-Pedersen saveall was installed for the treatment of the backwater from the board machine. All solid matter is entirely separated, so that the water discharged from the saveall is not only used for dilution in the process, but also for the high-pressure sprays of the board machine. Consequently, the water system of the mill is practically closed.

After the successful start-up of the mill which was constructed under their supervision, Celdecor Africa (Pty.) Ltd., were appointed managing agents for the mill.

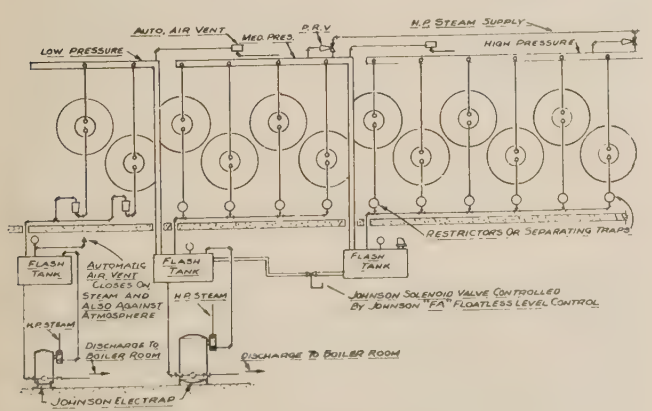
Drainage System for Paper Machines

Improved drainage of paper machines and considerable economies in returning condensate to boiler room are two of the benefits reported from the installation of a new drainage system engineered around the Electrap, an electrically operated pumping trap manufactured by the Johnson Corp. of Three Rivers, Mich.

This new system fits into the generally accepted practice of dividing drier rolls into three groups, which use steam at successively lower pressures. In the usual system the first two groups, starting at the high-pressure dry end, are drained into steam separators or flash tanks which make some flash steam available for the next lower pressure group. Pressure reducing valves add whatever additional steam is required. The last group, at the wet end, is usually drained by separating traps. Some means must be provided to return final condensate to boiler room—ordinarily a centrifugal pump which operates continuously throughout the day. This may require a condenser or cooler for drainage from wet-end rolls, which uses cold water to reduce condensate to a pumpable temperature.

In this new system, two Electraps are used in place of the usual centrifugal pump and condenser. High-pressure steam is admitted to each unit during operating cycles, to force condensate back to boiler room. This steam used for pumping is then utilized to heat rolls or to improve drainage.

The figure shows how high-pressure rolls at the dry end are drained into a flash tank. Flash steam from this is then conducted to the second group of rolls, which in turn are drained into a second flash tank which helps to supply the wet end rolls. This last group is drained by separating traps into a receiver.



Application of Johnson Electrap to paper machine drainage

The pressure differential permits draining condensate from the first flash tank into the second, through a direct-operated solenoid valve which is controlled automatically by a floatless control in first flash tank. As condensate accumulates in the second flash tank and in the receiver at the wet end, the Electraps shown discharge it back to the boiler room.

Note that the first unit is vented to flash tank. This means that steam used for pumping is made available to supply wet-end rolls, thus reducing the amount of steam which must be added through the pressure-reducing valve.

Note that second unit is similarly vented to receiver. This receiver is equipped with an automatic vent valve which opens to permit the discharge of noncondensable gases but which does not permit either the escape of steam or entrance of air. When the steam used for pumping is vented to receiver, it consequently forces out all noncondensable gases. Then, if condensate entering receiver is below 212°, it condenses the steam and allows the unit to go into a vacuum condition. This increases the differential across the separating traps, creating better drainage of the wet-end drier rolls.

Oco Water Systems, Inc., Is Organized

Practicable means, permitting the recovery and reuse of paper-mill process water has long been desirable because of the need to: (1) conserve diminishing supplies of fresh water, (2) recover heat and material which goes to waste with the discharged water, (3) to eliminate pollution caused by the discharge of such waste water into streams, and (4) obtain best quality water possible for cleaning and processing high-grade products.

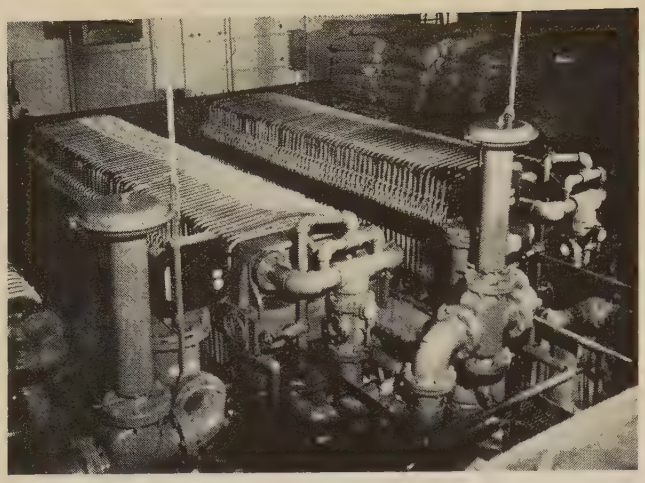
A solution to the problem has been especially difficult because of the tremendous quantities of water used in the papermaking process and because of lack of equipment which would effectively render it completely free of suspended fibers and other solids.

The development of the "Oco Water System" is the result of nearly eight years of research and experimental plant operation. The research program was decided upon early in 1943 by the Ohio Boxboard Co. of Rittman, Ohio, and was delegated to its technical staff following many years of experience with and study of "savealls" and other systems that have, over the years, proved of value to the paper industry.

The Ohio Boxboard Co.'s requirement specifications were severe and reflected their own necessity and the then-considered future yardstick that might be used in all industry. What was good practice in the past and sufficed would not, so they predicted, satisfy future demands. All fiber should be recovered or made available for reuse; heat waste should be drastically decreased or stopped altogether; water volume used, pumped, and piped should be cut down and with it all, an easily obtained and maintained "sterile" mill stock system should be had—and stream pollution controlled.

Essentially the "Oco System" involves the selective return of high solids process water to the system and the complete filtration of the remaining low solids water by a specially developed mechanical filter so that the filtered water is entirely suitable for low-volume high-pressure felt and wire showers. In most cases, the recovered solids are reused satisfactorily as furnish. The Oco system with its continuous reuse of the process white water can be employed successfully in practically all board and paper mills regardless of the size of the operation or the water volumes involved. The system is simple and requires small space area.

The complete filtration, accompanied by a 95% removal of all types of bacteria, makes possible a completely closed water system.



Operating view of OCO water system filters

Last February the Ohio Boxboard Co. at Rittman, Ohio, put into operation on two of their four board machines such a system. Six months' operation has produced sufficiently encouraging results to show that the principles of the Oco water system are sound and to warrant use on the original two machines and consideration of the extension to the other two machines in the future.

In the fast-developing desire for and necessity of "clear streams" throughout the country, the Oco water system has a definite place. It is not, as yet, applicable to chemical pulp mills but is a low initial cost means of solving the problem in paper and board mills. Its installation represents, where it is applicable, an investment opportunity in itself.

The Ohio Boxboard Co. has found that their system, while operating on but two of their four machines, has benefited them substantially in many ways not originally contemplated. They report a shortening of the investment write-off period under that originally estimated. Among the factors contributing to this saving in addition to those already named are: increase in felt life, reduction of power for pumping, high clarity of the filtered water reducing the tinge factor, and raising the value of the paper produced beause of its sharpened brightness.

The company reports that the heat-saving factor about equals the cost of the filter aid, alum, filter papers, and chlorine used in the filters.

A portable laboratory setup has been developed by Oco Water Systems, Inc., which can be taken into any mill, and an accurate test program has been worked out. The report and explanation of data so obtained show what the system will do in the mill tested, what the installation will cost, and what savings against this investment can be expected.

Two Oco systems (including the Ohio Boxboard Co. installation at Rittman) are in operation; another installation will be functioning in November and at least two more about the first of the year. Over a dozen mills have been surveyed. Estimated investment return is from six months to three years. Studies of application to rubber, textile, coal, and steel have been made and further work in other industries is proceeding as fast as time and personnel facility allows.

"Oco" filters are manufactured in the United States by two recognized machinery builders. For all installations east of the Mississippi River, equipment will be manufactured by The Sandy Hill Iron & Brass Works of Hudson Falls, N. Y., who also will handle export business, except Canada, and who have exclusive sales rights in the eastern area except in the states of Ohio, Indiana, Kentucky, Tennessee, Michigan, Illinois, and Wisconsin where sales rights are held by E. C. Jacobi of Green Bay, Wis. The Valley Foundry and Machine Co. of Fresno, Calif. will manufacture all Oco filters sold to pulp and paper mills west of the Mississippi. Sales rights for the west coast are held by A. H. Lundberg of 308 Orpheum Building, 1900 Fifth Ave., Seattle 1, Wash., and his associate, C. L. Koerner of 7604 Southeast 17th Ave., Portland 2, Ore.

Sales and manufacturing rights for Canada will be announced in the near future. Inquiries from Canadian mills are now being handled directly through the Oco Water Systems, Inc., at Rittman, Ohio, where E. L. Lukemire, Vice-President and General Sales Manager, has offices.

As of Aug. 1, 1950, Oco Water Systems, Inc., formerly a wholly owned subsidiary of the Ohio Boxboard Co., was sold to C. E. Carpenter, who retires as Vice-President of Ohio Boxboard Co. on Jan. 1, 1951. Mr. Carpenter has been President of Oco Water Systems, Inc., since its organization and now becomes President and Treasurer. With Mr. Lukemire, he will operate the company under the exclusive sales and license agreement with the Ohio Boxboard who own all covering patent applications. The main office of the company is at Fort Miller, N. Y., where Mr. Carpenter has maintained a residence for many years.

OBITUARIES

A. Fred Crossman

A. Fred Crossman, President of the Lindsay Wire Weaving Co., Cleveland, Ohio, died suddenly after attending the Navy-Notre Dame football game on Nov. 4, 1950. He was 59. Having joined the Lindsay organization in May, 1920, Mr. Crossman was elected President in January, 1932, upon the death of the founder, Hamilton Lindsay.

A. Fred Crossman

In addition to his many industrial relationships, Mr. Crossman's activities were broad in scope. A 32nd degree Mason, he also was a member of the Cleveland Athletic Club, the Shaker Country Club, and Rotary Club. He was a member of the board of St. Luke's Hospital in Cleveland, as well as a trustee of Baldwin-Wallace College, Berea, Ohio.

James Murray

James Murray, Superintendent and Chief Chemist of the Martin Cantine Co., Saugerties, N. Y., died suddenly from a coronary occlusion on Oct. 23, 1950. He was born in Lawrence, Mass., on July 27, 1886, and graduated from Lowell Textile School in 1913.

From 1913 to 1916 he was Chief Chemist of the Nashua Gummed and Coated Paper Co., Nashua, N. H., from 1916

to 1919 he was Chemist and Manager of the Crescent Color and Chemical Works, New York City, from 1919 to 1922 he was Chief Chemist of the Pawtucket Glazed Paper Co., Pawtucket, R. I., in 1922 and 1923 he was Manager and Superintendent of the Blackstone Glazed Paper Co., Pawtucket, R. I., from 1924 until 1930 he was Chemist for the Appleton Coated Paper Co., Appleton, Wis. He joined the Martin Cantine Co., in 1930.

He leaves a widow, six married daughters, and two sisters. Mr. Murray became a member of the Technical Association of the Pulp and Paper Industry in 1915, the year the Association was founded.

Harry Thomas Newman

Harry T. Newman, Director of Laboratories, Department of Purchase, New York, N. Y., died on March 5, 1950, of a heart ailment, at his home, 1163 Halsey Street, Brooklyn, N. Y.

Mr. Newman was born in Brooklyn on Dec. 3, 1893, and attended the Polytechnic Institute of Brooklyn. He joined the New York City Central Laboratory in 1912 and became Director in 1946. He was a member of TAPPI since 1947.

L. G. Vande Bogart

L. G. Vande Bogart, Research Engineer in the corrosion field for Crane Co., Chicago, Ill., died on September 10 at Chicago.

Mr. Vande Bogart was born at Sheboygan Falls, Wis., on Jan. 29, 1892 and studied chemical engineering at Valparaiso University and the University of Chicago. Prior to joining the Crane Co., in 1923 he was an analytical chemist for the U. S. Steel Corp., and the International Harvester Co., both in Chicago. In the Technical Association of the Pulp and Paper Industry he was active for many years on the Corrosion and Materials of Construction Committee which is now the TAPPI Mill Maintenance and Materials Committee.

LETTERS TO THE EDITOR

Mill and Laboratory Beaters

To the Editor *Tappi:*

In your issue of August, 1950, you printed a letter sent by Dr. Clark to the *APPITA News Letter* in which he objects to the use of freeness as a basis for comparing beating results and refers to his advocacy of the use of apparent density of the test sheet for this purpose. I wish to point out in the first place that in the work that was published from this laboratory by Mr. Laugher (*APPITA Proc.* 2: 17, 155), care was taken to compare the beating effects of mill and laboratory beaters by a conspectus of all those properties determined, i.e., burst, tear, bulk, and freeness. This was done by a graphical method in which comparisons were made through the time scales. The main conclusions about the degrees of correlation found with the particular pulps concerned were thus reached without placing much emphasis on the significance or practical value of freeness.

It was essential in our work to take particular notice of the wet-working properties of the stuff on the paper-machine wire, and this presumably is commonly the position when assessing the results of beating trials. The value, then, of using the density as the basis of comparisons between beatings would be very substantial if it could be assumed with Clark (*Pulp Paper Mag.*, Canada, 49: 10, 101, Sept. 10, 1948) that density is a measure of "running quality" by which wet-working quality is presumably meant. Investigation of this subject by the use of an experimental paper machine would surely be very valuable; adequate experimentation with the recirculating load of fines, the dilution of the stuff, and other factors in a dynamic system being necessary for this.

Incidentally to Dr. Clark's use of density and his finding that this shows a straight-line relation to the log revolutions per gram, I might mention that we have found the bulk to give this straight line much more regularly; this has been found so in extended series of beatings, with the Clark kollergang, of bleached and unbleached eucalypt sulphate, as well as of unbleached coniferous sulphite pulps.

J. L. Somerville
Australian Newsprint Mills Ltd.
Boyer, Tasmania

Paper and Packaging Specifications

U. S. GOVERNMENT SPECIFICATIONS

Following is information from B. W. Scribner, National Bureau of Standards, Chairman, Technical Committee on Paper and Paper Products, Federal Specifications Board, on revised or new Federal specifications of recent issue:

UU-C-834 (new) Cups and Lids, Paper, Hot Food or Drink, Price, 5 cents.

This was developed with the assistance of the Technical Committee of the Paper Cup and Container Institute and has the approval of the Institute. Requirements are specified for capacity and weight of the cups, bursting strength and thickness of the paper, depth of lid seat, and bottom recess. The weight and thickness of the lids are specified. This is the first standardization of paper cups, and the Institute is to be commended for effecting a very difficult standardization. A specification for cold-drink cups and lids is under development.

UU-S-48b (revision) Sacks, Paper, Shipping, Price, 10 cents.

The requirements include construction, with specific requirements for adhesive and dipping or sealing compound, and detailed specifications for plain, wet-strength, asphalted and paraffined kraft papers. The most important changes made by the revision are in the requirements for the asphalted paper, and by the addition of specific construction requirements for bags for overseas shipments of 134 different commodities. The revision was developed largely by The Technical Committee of the Paper Shipping Sack Manufacturers Association, and it was approved by the entire membership.

UU-B-36b (revision) Bags, Paper, Grocers, Price, 10 cents.

The important changes made by the revision are decreases in the bursting strength requirements compensated by increases in the tearing strength requirements. The changes were made on the recommendation of the Paper Bag Institute to bring these requirements in line with the properties of kraft paper as presently manufactured for grocers' bags.

UU-P-236a (revision) Paper, Filter, Analytical, Price, 5 cents.

Former title: Paper, Filtering.

Important new requirements, based on the results of research at the National Bureau of Standards, have been added to the specification. These are for alpha-cellulose content, copper number, acidity and time of flow of water. The first three are included because they are of importance relative to the purity of the cellulose and the stability of the papers. A high alpha-cellulose content and a low copper number are characteristic of cellulose of a high degree of purity, that is, cellulose that has not been degraded appreciably. Degraded cellulose is partially soluble in some solutions and therefore may pass into filtrates and cause erroneous analytical results. Both degraded cellulose and high acidity result in unstable paper that may become too brittle for satisfactory use.

(Copies of Federal specifications and the Federal Specifications Index may be obtained on application accompanied by postal note, money order, coupon or cash to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. The price of the Index is 35 cents.)

LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel and Events

The Stewardship of a Local Section

R. G. MACDONALD

When the Chairman of your Program Committee asked me to participate in this program, commemorating the fifteenth anniversary of the Ohio Section, he suggested that I indicate what the national organization expects of the section. Although I will discuss that subject later, I feel that this meeting is a celebration of fifteen successful years of your section.

As in the case of all sections, I was involved in some of the preliminaries leading to the formation of this group. In all such situations there is usually one individual who takes the initiative and does much of the hard work concerned with getting such a body formed. In the case of the Ohio Section it was Vincent Waters, then chief engineer of The Wrenn Paper Co., in Middletown, and now Editor and General Manager of the Southern Pulp and Paper Manufacturer in Atlanta. Between these two jobs he was for awhile with the Champion Paper and Fibre Co., in Hamilton, and was Technical Assistant to the Secretary of TAPPI in New York.

I wrote to Vince and asked him to let me have his recollections of the early days of the Section. Vince wrote me as follows:

"After I was located in the Miami Valley for about six months I felt that there was a need for an organization that would bring together the engineers, superintendents, chemists, and operating executives to discuss common problems. I discussed this matter with Carl Roess, chief chemist, and Joe Hallowell, then vice-president and general manager of The Wrenn Paper Co. They expressed considerable enthusiasm. I then wrote to you to find out how to go about establishing a local section. You responded with a long letter concerning the procedure to follow. You impressed me with the necessity of getting a group organized that would have the ability to stand on its own feet and develop leaders that would perpetuate the organization.

"You suggested that a few association members be called together to discuss the prospects of such an organization. I then invited Carl Roess, Joe Wallace, O. P. Gephart, George Harvey, Homer Latimer, Kenneth Geohegan, Ralph B. Roe, and possibly a few others to meet with me at the Manchester Hotel. The reaction to the proposal to start a local section was on the favorable side, although it was felt that we should proceed with caution since an informal Miami Valley Section had been formed in the 20's that had not survived. Following this meeting a letter was sent to fifty-five members in Ohio, of which 25 replies were received, all favorable to the plan.

"After another meeting of the organizing committee the first official meeting of the Ohio TAPPI Group was held on April 20, 1934, at the Manchester. At this meeting you were the principal speaker. There were sixty-five present. The meeting was enthusiastic, as such meetings go. Homer Latimer acted as meeting chairman and appointed L. C. Currier, Vincent Waters, and George Hermann as a committee to nominate provisional officers. The provisional officers nominated and elected were J. H. Wallace, Chairman; George Harvey, Vice-Chairman (now both deceased); E. C. Hendrickson, O. P. Gephart, R. B. Roe (deceased), C. D. Roess, and John F. Ohlson as Committeemen. In addition to yourself the speakers at this meeting were George H. Harvey, Gardner-Richardson Co., D. E. Lewellen, Lewellen Mfg. Co., and Harry G. Specht, Eastwood Wire Co.

"The next meeting was held on Feb. 15, 1935, at which the late Carl E. Curran of the Forest Products Laboratory, Madison, Wis., and Harry F. Lewis of the Institute of Paper Chemistry, Appleton, Wis., were speakers. Homer Latimer presided in place of Joe Wallace who was out of town.

"On April 20, 1935, Robert F. Reed of the Lithographic National Foundation and George Munro of the Champion Coated Paper Co., were the speakers. At this meeting a formal selection of officers was completed since the provisonal committee felt that the success of the Group was assured and a permanent organization was warranted. The following officers were elected:

President—Vincent F. Waters, Wrenn Paper Co., Middletown, Ohio
1st Vice-President—J. J. O'Connor, Mead Corp., Chillicothe, Ohio
2nd Vice-President—Homer H. Latimer, Beckett Paper Co., Hamilton, Ohio
Secretary-Treasurer—Carl Roess, Wrenn Paper, Co., Middletown, Ohio
Director—George H. Harvey, Gardner-Richardson Co., Middletown, Ohio

"At this meeting the members voted to apply formally to the National Executive Committee of TAPPI for a local section charter.

"The TAPPI Ohio Group developed rapidly and on a firm foundation when we were advised that the Executive Committee had approved our petition for a charter. On Oct. 19, 1935, Clark C. Heritage, President of TAPPI and you were present. As Chairman I called on you for a talk and to introduce Mr. Heritage. Clark took as his subject "Why be a TAPPIMAN?" He then presented the charter of the Ohio Section, the banner, and the gavel, all of which were accepted by me for the Section. In the business meeting that followed E. C. Hendrickson of the Mead Corp., Chillicothe, Ohio, made a motion that the provisional officers be elected as officers of the Section. This motion was seconded by Kenneth P. Geohegan of the Aetna Paper Co., Dayton, Ohio. The motion was carried unanimously and the officers were the same as those elected at the April 20 meeting.

"During the following months the Ohio Section carried on an intensive development of good programs and cooperation with the Miami Valley Division of the American Pulp and Paper Mill Superintendents Association. Various joint meetings of the Division and the Section were arranged with excellent results.

"I was re-elected Chairman in 1936 and again in 1937 and was succeeded in 1938 by Homer Latimer. Following the activities of the Ohio Section has been very interesting to me, and the steady gain in membership (five times since 1934) and attendance at the meetings, under the ten chairmen who followed me, speaks well of the value of the Ohio Section to its members and their companies.

"In closing I wish to draw particular attention to the great amount of work done by Carl Roess as the Secretary-Treasurer of the Group and Section during my three terms of office. Carl was the principal spark plug for ideas about meeting programs and in the discussions leading up to the formation of the section. Frankly, without the help of you and Carl, I doubt if I would have pushed and worked as I did for the formation of the Section because there was a tremendous

R. G. MACDONALD, Secretary Treasurer, Technical Association of the Pulp and Paper Industry, New York, N. Y. Talk given at the 15th Anniversary Meeting of the TAPPI Ohio Section, Manchester Hotel, Middletown, Ohio, Nov. 9, 1950.

amount of effort required, plus the fact that there were strong discouraging factors."

So much for the early growing pains of this Section. Fifteen years have passed by and we have a live, thriving organization with plenty of potential leadership that augurs well for the future.

At the national fall meeting of the Association that was held in Portland, Ore., in 1949 it was noted that this meeting coincided with the twentieth anniversary of the Pacific Section. In connection with this I took as the subject of my talk "Local Sections in a Professional Society." This talk was published in the October, 1949, issue of *Tappi*. This talk dealt with the early history and the development of the Section, a Section that has accomplished much under good leadership.

In this talk I pointed out that to many the local section is TAPPI itself. What the section does, what kind of leadership it has, the type of programs that it presents, and the participation of its members in those programs tends to reflect the Association as a whole to many, including company executives that are not otherwise familiar with the activities and accomplishments of the national organization.

To some extent the local sections of TAPPI differ from the sections of the major professional societies such as the A.C.S., A.S.M.E., etc. The standards of the latter are quite high and their programs are often on the same high plane as the national society. In the case of TAPPI, its sections tend to be devoted to training grounds for the younger employees of the pulp and paper companies of the region. Although high standards are desired, it is kept in mind that the section attracts a large number of nonmembers of the association and, in particular, young people who are anxious to attain the rudiments of their professions as quickly as possible.

The programs are directed largely toward obtaining a better understanding of operating problems, presented in a manner that can readily be understood. It is seldom that papers are presented that give, for the first time, the detailed results of research effort and would therefore be eligible for consideration by the Editorial Board of *Tappi*. The time may come when these high standards may be expected but it has not done so, to date, to any considerable extent. In the meanwhile the present type of programs and meetings are to be expected. Even so, it is the desire of the TAPPI Executive Committee that such programs as are presented be maintained at a high quality caliber. Any paper that is presented should be up to TAPPI Editorial Board Standards. In other words, sections and speakers should take themselves seriously and not do a "half-baked" job.

If our sections wish to consider themselves as training organizations the programs should be developed on a systematic basis. The subjects of importance should be well thought out and when this is done the best speakers available should be obtained. To meet the training objective definite arrangements should be made to assure participation by as many as possible at each meeting. It is not enough to simply find a speaker who is willing to talk and to ask him a few questions. The meetings will serve their purpose best if there is an extensive and positive exchange of information. If a subject is selected, an organized group, possibly a panel, should be on hand to present all of the aspects of the subject, so that when the meeting is over all who have taken the time to attend will feel that the time was well spent. As a matter of fact those individuals who contribute information to the meeting will be the ones that will be most likely to have this feeling.

Since this is a technical organization it is committed to programs of a technical nature. By the word technical, I mean that any statements made are based on careful observations, reliable measurements and sound interpretations.

The publications of the Association tend to reflect the organization's activities and the emphasis that has been put on quality. The TAPPI Standards represent the effort of a very large number of our members over many years. A single method may require consideration over several years before the Association gives it official approval. The TAPPI Data Sheets are now being prepared under the direction of a committee made up of representatives of the committees of our Engineering Division. As many as twenty judges may see each sheet and approve it before it is published. *The Bibliographies of Paper Making* are prepared each year by one of the outstanding bibliographers of this country. The TAPPI Monographs on selected subjects are read, and criticized, by a large number of competent members before it finally gets into print, and *Tappi*, the Association magazine, is under continual surveillance by an Editorial Board that decides if and when an article is ready for publication.

These high-quality publication requirements of the national association may appear to be a high wall to be scaled and may make you wonder what you can do. By *you* I mean the individual *you*, for everything that finally appears in print has to start with the effort of an individual. Our national committees undertake the main task of getting these items on the road to publication. Many individuals volunteer contributions.

The local sections can do more than they are now doing to bridge the gap between the individual and the Association. It can induce individuals to present papers; it can promote group research activity that will result in publications; it can induce its members to prepare data sheets; it can undertake the preparation of a monograph; it can sponsor the activities of a national committee, just as our Pacific Section is now sponsoring our Acid Pulping Committee. It can start the important development of a testing method. It is in the field of preparing routine mill control methods that a section can be pre-eminent. Any method of testing that is proving to be a reliable control should be offered to the Association.

Of all of the aforementioned, a large number of members of this section have much to offer. The problem is to overcome the inertia of indifference or reticence in getting these items moving from the individual to the Association. It is here that the section can play an important role. It should organize itself to accomplish these ends. Very little happens unless someone provides the initiative and the ways and means. Your officers and executive committee can get by if they do nothing but schedule a series of meetings such as this. If it is a superior group it will supply the leadership that will create high-grade publications, data sheets, monographs, routine control methods, suggested methods, and recommended practices. It can stimulate its members to make important contributions to the Association.

In an organization where no one need present a paper, serve on a committee, function as a section officer, or make any personal contribution to his fellow members, it requires a feeling of responsibility on the part of someone to do anything. The Association has been fortunate over the years that so many have been willing to contribute their time and effort to enable the Association to serve its members. Many are undoubtedly willing to do something but do not know how to proceed. Organization at the section level can bring these contributions to fruition. So much is done for so many at present by so few that any effort that you make will be welcome. The burden of accomplishing all of these things rests on your section chairman. He can do all of these things himself, if he has time, or he can establish a large working organization made up of all of you members of the section that can, in time, produce a great reservoir of useful information. The important thing is to remember that the Association is made up of *"you and you"* and is not some mystical body called *"they"* who provide these items for you. Again, I say that all of you will contribute your share if someone will provide the leadership. In a section that leader is the Chairman. When he calls on you to do a job for the Section or the Association tell him that you will do the best that you can to cooperate and contribute. You will enjoy the feeling of accomplishment.

Delaware Valley

"Pulp Refining and the Curlator" was discussed by James T. Coghill, Vice-President of the Curlator Corp., as he addressed the members and guests of the Delaware Valley Section at a dinner meeting at the Engineers Club in Philadelphia on Oct. 26, 1950.

Mr. Coghill took an active part in the development of the Curlator, and in his introductory remarks, he related how curlated pulp came to the attention of Price Brothers Co., Ltd., in Quebec, and how the effect of curlation was studied by H. S. Hill and J. Edwards and their associates there. Mr. Coghill then described the mechanical aspects of the Curlator, which consists essentially of a stationary lower plate and a gyrating upper plate which is free to float vertically. Nodules of high consistency pulp, 18 to 24%, are caused to roll in continuously changing directions between the surfaces of these two plates. Hydraulic pressure is applied to the gyrating upper plate compressing these nodules while they roll. The action of the Curlator may be easily duplicated on a small scale by placing a lump of pulp, of about 20% consistency, on a table top and then breaking down the lump into nodules by the movement of the flat of the hand using a gyratory-type motion under pressure.

Mr. Coghill then went on to describe the effect of curlation with particular reference to high-yield newsprint sulphite. A permanent change in the shape of pulp fibers is obtained by the mechanical rolling action. The fibers possess more bends, kinks, and twists, and a more tubular cross section. The mechanical action of the Curlator is very efficient in defibering shives and screenings. Mr. Coghill said that curlated pulp gives higher drainage rates, increased tear, reduced burst, increased porosity, and possesses higher scratch and greater softness.

This new approach to pulp treatment indicates a wide variety of possible applications. The discussion from the floor gave evidence of the members' enthusiastic reception of Mr. Coghill's very interesting talk.

Question: Is generation of heat a problem in the curlation process?

Mr. Coghill: No, since very little power is consumed—under 4 hp. per ton.

Question: Has curlation been tried on groundwood?

Mr. Coghill: Yes. In fact, excellent groundwood has been produced from excelsior and tailings but the power consumption is considered prohibitive.

Question: Has rag stock been subjected to curlation?

Mr. Coghill: Rag stock becomes hopelessly tied in knots.

Question: Has there been any exploratory work on wastepaper?

Mr. Coghill: Yes, on a laboratory scale. The results are practically the same as with pulp. In fact, papers highly resistant to disintegration, such as map, blueprint, and wet-strength toweling, are defibered readily.

Question: What happens if a pulp is refined and then subjected to curlation?

Mr. Coghill: In general, curlation of refined pulp produces the same trend of property changes that you would normally expect from curlation alone, i.e., decreased burst and increased tear, porosity and stretch.

Question: Has there been any exploratory work on curlation of kraft pulp?

Mr. Coghill: Yes, but the power input for curlation of kraft is somewhat higher than that for sulphite. Kraft tailings require roughly three times as much power as sulphite.

Question: What increase may be expected in pulp yield by subjecting tailings to curlation?

Mr. Coghill: Since curlation exerts a powerful deshiving action, it is possible to increase pulp yield about 7% by increasing the chlorine number, at the same time decreasing wood usage by 10% through simultaneous reduction of the tailings rejected.

E. R. Padavic

Pacific

The first meeting of Pacific Section in the 1950–1951 season was held at Bagley Hall, University of Washington, Wednesday, Sept. 13, 1950. E. O. Ericsson, Technical Director Puget Sound Pulp & Timber Co. and Vice-Chairman of the Pacific Section, had arranged a panel discussion of Pulp Purification for which Raymond S. Hatch, Monterey, Calif., presided as moderator.

In opening the meeting, Mr. Hatch reviewed the important historical developments in the pulp purification field with particular emphasis on the more recent trends in the industry. Three papers on the subject were presented, summaries of which follow.

"Purified Sulphate Wood Pulp for Viscose Rayon" by F. A. Simmonds, Forest Products Laboratory, Madison, Wis.

Investigations of the suitability of purified sulphate wood pulp for viscose rayon are considered important because the sulphate process is suited to the pulping of all kinds of wood. Although limited in supply, a softwood sulphate viscose pulp is made in Sweden and facilities for the production of a hardwood variety in the United States have been announced. It has been reported that tire-cord rayon of high quality has been made experimentally in this country from the Swedish pulp.

It appears from published investigations on sulphate wood pulps for making viscose rayon that the most troublesome factor in their use is the filtrability of the viscose solution. The characteristics of a pulp which control filtrability are not identified in the literature. However, a frequently encountered opinion is that the causes of poor filtrability lie in the relatively small noncellulosic fraction. The kind and structure of the cells which compose a pulp and the length of cellulose chains have been cited also as possible factors influencing filtrability. Of the noncellulosic components, the pentosans are considered to be especially undesirable in a dissolving pulp, yet it has been stated that as much as 4% may be tolerated in a viscose pulp.

The relatively high pentosan content of conventional sulphate pulps has led to much work in both pumping and purification to facilitate the removal of these and other hemicelluloses. Comprehensive reviews of the literature on this problem and others mentioned in the foregoing have appeared during the last 5 years, those of the Australian investigator, Alexander Meller, being especially noteworthy.

A mild acid hydrolysis of chips prior to cooking them in sulphate liquor is the favored treatment for removing pentosans and other hemicelluloses. Some investigators believe this hydrolysis also has a more direct, although unidentified, beneficial effect on the response of the pulp to the viscose-making process.

Work on sulphate-dissolving pulps is being done at the Forest Products Laboratory to establish practical combinations of pulping and purification procedures in accordance with the requirements of various kinds of wood, especially the hardwoods, and to determine the yield and quality of the purified pulps. Sulphate pulps made both with and without prehydrolysis are being purified and evaluated, and both the hot and cold alkaline extraction treatments are being tried in the purification sequence.

Present indications are that for prehydrolysis, a water cook in which a maximum temperature in the range of 160 to 170°C. is attained in $^3/_4$ to 1 hour and maintained up to 30 minutes is adequate, even for hardwoods. However, steam cooking can be used for this purpose. Under these conditions, the organic acids formed result in a pH in the range of 3 to 4. Following prehydrolysis, the sulphate cooking has been done with approximately 20% total chemical, 30% sulphidity, a maximum temperature of 170°C., attained in 1 to 1.5 hours and maintained for 1 to 1.5 hours. Without prehydrolysis, the total chemical used has been 27.5% for softwoods and 22.5% for hardwoods, and the time to and at maximum temperature 1.5 hours, respectively.

In general, purification has comprised one stage of chlorination, one of extraction with sodium hydroxide or sulphate cooking liquor, and one of oxidation with sodium hypochlorite

or chlorine dioxide. However, the effects of mild hydrolysis immediately following almost complete exhaustion of chlorine, variation in the sequence of extraction and oxidation stages, and multiple oxidation stages are being determined. For pulps made under the conditions used without prehydrolysis, the cold alkaline extraction treatment is necessary to increase the proportion of alpha-cellulose in the purified pulp to 95.5%, the value typical of the tire-cord grade of pulp. In this treatment the temperature used has been 25°C. and the concentration of the alkali solution from 6 to 15% depending on the nature of the unbleached pulp. For the prehydrolysis-sulphate pulps, the hot alkaline extraction treatment appears to be sufficiently drastic and the conditions used have varied from 3% alkali based on the pulp and 80°C. to 15% alkali and 130°C., all at 10% consistence, depending on the nature of the pulp.

Yields of purified pulps have ranged from 33 to 42% of the wood, depending on the wood and the conditions of preparation.

The experimental pulps are being compared with commercial dissolving pulps by means of conventional test values, their behavior during conversion to viscose, the filtration characteristics of viscose solutions, and spinning trials of promising pulps.

Some sulphate pulps made without prehydrolysis and with purification treatments involving hot or cold alkaline extractions have given viscose solutions of filtration quality comparable to a commercial prehydrolysis-sulphate softwood pulp. However, pulps made in the same way from other samples of similar wood gave nonfiltrable viscose solutions. At the present, it appears that a prehydrolysis step is essential to assure consistently filtrable viscose solutions. With a prehydrolysis step and hot alkaline extraction in the purification, a pine pulp of about 93% alpha-cellulose has been obtained that gave a viscose solution having a high order of filtrability. Experimental prehydrolysis-sulphate hardwood pulps subjected to spinning trials were reported to have reacted normally to the viscose-making process and the textile yarn to have been of commercially acceptable quality.

"Some Factors Affecting the Alpha-Cellulose Test" by John McNair, Pulp Division, Weyerhaeuser Timber Co.

The alpha-cellulose test is empirical in nature and there are numerous factors which have a bearing on the level and reproducibility of the test results. Modifications in the testing procedure may or may not become critical, depending upon the method of isolation and the previous history of the sample being tested. Thus, on certain pulps, modifications in the testing technique have very little influence on the test results, while on other pulps of different origins such modifications in testing procedure may be very critical. Some pulps are much more sensitive to modifications in the testing technique, and this sensitivity is not directly related to the alpha-cellulose level.

The following factors seem to have a critical effect upon the results obtained:

1. Method of preparing sample for testing (shredding, grinding, or cutting).
2. Temperature of the dilution stage.
3. Time interval of dilution before filtering.
4. The type of caustic used in the mercerization stage, that is, the use of grades other than CP caustic.

The temperature of the mercerizing caustic and the rate of filtration have a slight but significant effect on the test results.

The following factors have little or no effect on the test results—precooling of test specimen and beaker, moderate variations in mercerizing time, variations of 2% or less in volumes of mercerizing solutions and dilution water, the temperature of the cold wash water, the time of drying the moisture samples and alpha-cellulose residues (drying overnight as compared to drying only to constant weight), and finally the use of a vacuum oven as compared with a circulating oven at 105°C.

It should be emphasized that the origin and preparation of the sample have a decided bearing on its sensitivity to variations in the alpha cellulose test. For this reason, in determining the effect of certain testing variables it is desirable to test these effects on pulps from different wood species, prepared by widely different cooking and bleaching processes.

"Chlorine Dioxide and Its Use as a Bleaching Agent for Wood Pulp" by A. Halvor Lundberg, Chemical Pulp Mill Engineer, Seattle, Wash.

About twenty years ago Professor Eric Schmidt aroused interest in chlorine dioxide as a bleaching agent when he showed that the total carbohydrate fraction of cellulose raw materials could be isolated with this reagent without appreciable degradation. Schmidt's laboratory technique has since been modified so that chlorine dioxide can be used for commercially bleaching cellulose fibers to a high brightness.

The great advantage of using chlorine dioxide is that bleaching can be accomplished without loss of strength, whereas some loss is invariably experienced with chlorine-hypochlorite. The disadvantages of chlorine dioxide are high cost and the difficulty of producing and handling the chlorine dioxide because of its corrosive and explosive nature. The demand for high quality pulp, however, has resulted in chlorine dioxide bleaching in several pulp mills outside this country.

Chlorine dioxide bleaching became more feasible from the economic point of view when it was shown that the main part of the incrusting substances may be removed with the cheaper chlorine and hypochlorite and chlorine dioxide used only in the final stages. Examples were presented to illustrate the method of bleaching and the properties of bleached pulp as compared with those of pulp bleached with chlorine-hypochlorite. It was also pointed out that two or more mild treatments with chlorine dioxide give better results than one intensive one.

Following the afternoon technical meeting, TAPPI members and friends were guests of Pacific Section at a reception in the Edmond Meany Hotel near the University of Washington campus.

J. A. Van den Akker, The Institute of Paper Chemistry, Appleton, Wis., was guest speaker at the evening meeting which followed dinner. Mr. Van den Akker, who had just concluded a two-day series of lectures at the TAPPI Seminar in Portland, gave his well-known and popular talk on "Color." With the aid of a color synthesizer developed at the Institute and a General Electric color mixer, he demonstrated in a most interesting manner many of the fundamental factors of color measurement.

R. M. TRUE

Chicago

The October meeting of the Chicago Section, of the Technical Association of the Pulp and Paper Industry was held at the Chicago Bar Association, Chicago, on Monday evening, Oct. 16, 1950.

The meeting was opened by Chairman A. K. Roach with the announcement that the constitution as revised by a special committee had been accepted by the executive committee. The revision represents the final phase of the change-over from the old Chicago Professional Paper Group to the Chicago Section, TAPPI. It will be put to a vote of the membership at the November meeting.

J. R. Fulghum, Socony Vacuum Oil Co., introduced the speaker of the evening, George Welp, Director of Sales Promotion and Advertising for the International Printing Ink Division of Interchemical Corp. Mr. Welp presented a color movie produced by I.P.I. showing the long way that printing and color reproduction have come since Gutenberg made his first experiment with movable type and since Isaac Newton made his notable demonstration with sunlight and a

prism. The movie took the viewers through the laboratories and plant operations of I.P.I. to explain what happens in formulating inks and what is required to manufacture printing ink so that it will meet today's printing conditions. Mr. Welp followed the movie with an illustrated talk "Putting the Rainbow to Work."

The use of the spectrophotometer in color work was described with enlarged graphs of various colors. He outlined the eventual aim of the colorimetrist—to have pigments available that have very definite reflectance in certain ranges which could be chosen for mixing to give the desired final color. Research has gone quite far in this work but has still a long way to go.

The construction of the Munsell color system with its hues, chromas, and values was developed, and colored felts were used to illustrate these terms and their meaning in the practical terms of legibility and visibility. Mr. Welp emphasized that the recognition of the effects of "simultaneous contrast" would make it possible to use color advantageously in difficult situations. That is, if one color is slightly different in chroma than desired, the net effect can be held approximately unchanged by varying the background.

The selection of colors is narrowed by the type of use to which the printed material is to be put. Pigments with the properties of light fastness, fastness to acids, alkalies, and alcohols are constantly being developed. Mr. Welp's final comments were on the subject of the effect of the paper surface and the difficulty of getting a strong, clean color on boards that differ greatly from white.

On the question of what type of instrumentation is suitable for plant color matching, Mr. Welp indicated that such instruments as the G. E. spectrophotometer have been recommended by them for many years. He does not feel that the human element will ever be taken from color matching, although a differential colorimeter developed at I.P.I. is now under test by one group and the preliminary reports are favorable. Of course, he emphasized, the matching of a color by its spectrophotometric characteristics can be done only with reference to given paper characteristics, film thicknesses, and other operating conditions that cannot be evaluated by the inkmaker.

In regard to color-density meters and their value, Mr. Weymouth, I.P.I., said that all of these instruments, such as the Hunter and the Densichron, depend on photoelectric cells. These cells have been found to change quite a large amount with time. The manufacturers of the instruments are beginning to recognize this defect and these instruments will be heard of more and more.

After the talk Mr. Welp was thanked for his excellent presentation and the meeting was adjourned.

September Meeting

The following two discussions were given at the September meeting of the Chicago Section which was held on Sept. 18, 1950.

The Role of a Packaging Engineer—Walter Stearn

Sometime ago Scott Hassler of the Curtiss Candy Co., defined the packaging engineer as a "general practitioner." I have seldom heard a definition that fits the subject so perfectly. The packaging engineer is rarely outstandingly an expert in a limited field; in most cases his knowledge is rather supposed to be encyclopedic and is, as usual in an encyclopedia, often somewhat sketchy. It is his responsibility to specify and arrange for the proper execution of a package which provides for the easiest handling during the entire process of merchandise distribution, affords the greatest possible protection against physical, chemical, and biological damage in transport and storage with the least expensive materials and the most economical application methods. It simultaneously guarantees, as far as possible, maximum assistance in carrying out the object of production, whether it be sales or just plain product effectiveness such as is imperative in the packaging efforts which have come into play in our present emergency.

In order to be able to do this, the packaging engineer qualifies through his knowledge of the characteristics and potentialities of various packaging materials, his knowledge of package and graphic arts production processes, his familiarity with his product's behavior under hazard and stress, and his comprehension of plant layout, machine engineering, and motion economy. When I mentioned earlier that his knowledge is of the encyclopedic type, I outlined another trait which you will find in packaging engineers: if he does not have firsthand specific knowledge of a subject, he knows where to find it, and I believe that is one of the reasons why so many packaging engineers have become members of TAPPI.

Any packaging engineer who wants to achieve his aim, whether it is the introduction of a new product, or the modified packaging of an oldtimer, will have to work closely with a multitude of agencies, organizations, inside and outside departments, and individuals. One of his prime assets will be his ability to obtain willing and active cooperation. A lot has been said about the packaging engineer's ability to "sell himself." It must be stressed again and again that the ability of the packaging engineer to sell himself to management and his collaborators is in most cases not a magic quality, but simply common sense, a thorough appreciation of the other fellow's problems, and an open-minded will to learn. He should have at least a fair comprehension of what makes a particular packaging machine tick and how his specifications may influence its rate of production and down time. He should be sufficiently design-conscious to realize that the package construction alone does not achieve sales and that color scheme, layout, typography, lettering, illustration, and copy have at least an equal share of importance in creating the package and may call for concessions in material or structure in order to achieve superior appearance. Above all, he should be fully conscious of any experience the package undergoes in its long way from original production to final use.

He will at all times have an accurate mental picture of the hazards encountered by the package during transportation, storage, and distribution to end use, of the impacts, shocks, and fatigues which it will experience, of the temperatures and humidity zones through which it will go, of the influences that will be called into play upon it from ultraviolet light to greases, from mold to vibration, from moisture to stacking stresses. He has spent interesting and informative hours in warehouses, freight yards, loading docks, and receiving stations and neither underestimates nor overemphasizes the destructive forces of human and mechanical handling. He will have struck close acquaintances with the machines that produce and package his product, with the laboratories which analyze it, with the purchasing agents who procure the raw materials, and with the merchandising and sales forces which effect its distribution. He will have first-hand knowledge of how the product is used and how the package can contribute to its value, and he will have arrived at his own conclusions regarding the often discussed entity of "reasonable damage percentage" and will neither be a perfectionist regardless of cost, nor a gambler satisfied with affixing an address label to his product and then trusting to the good fates, having performed a minor miracle of "economical packaging."

In most cases it will be his responsibility not only to specify certain packaging methods, but also to see to it that they can be carried out, and, to some extent, that they will be carried out. He will have to try constantly to narrow down the gap between executive order and final execution; his imagination and ingenuity will permit him to go far beyond standard styles and models in an attempt to provide the one best packaging solution. His mind will not be weighed down with the conventional approach to a packaging problem, and even under the stress of production deadlines—and this stress is ever-present—he will attempt to avoid the expedient and create the novel package.

Every package engineering department sooner or later has to choose between creating, through specialized training, a body of experts, or, by providing a maximum of broad practical experience, the "packaging encyclopedia on legs," which I mentioned before. In most cases the project nature of a packaging assignment has made the latter approach stand out as being by far the most practical. For instance, if in order to bring a new 1-ounce portion of a food produce in a transparent plastic package on the market, you would try to coordinate a Staff of Experts, here is what you would have on your payroll, (and I am considering only the narrow phase of packaging the product): A specialist in foils; a specialist in adhesives; a specialist in label papers; a specialist in multistation wrapper forming and filling machines with particular knowledge of European machine developments; a specialist in mold development: a specialist in bacteriology; an industrial engineer; a specialist in rigid transparent plastics and molding methods; a specialist in corrugated fiberboard cartons; a specialist in rotogravure, letterpress, and offset printing methods; a specialist in sealing and closing methods; a materials-handling engineer who specializes in palletization, and finally somebody who will attempt to coordinate the able efforts of this outstanding group of one dozen experts. If, on the other hand, you are looking

for somebody who will somehow get the product on the market successfully and on time, I think the packaging engineer will do.

The majority of craftsmen who are identified as packaging engineers do not fall into the category that packs everything from live bees to caskets, from imported Roquefort to rose bushes. The one thing they all have in common, however, is coordinating ability, and—an "encyclopedic knowledge of where you find encyclopedic information" in any specific field.

Let me sum up, then, what I wanted to make clear to you: Don't look to package engineering for highly specialized information. If, for instance, a packaging engineer knows enough about papermaking to appreciate the importance of slime control, if he knows enough about strapping to realize when to get advice from the flat steel strapping experts, when to look toward round metal strapping, and when to attempt experimentation in the reinforced paper strap field, he has all the knowledge required of a man whose main job is: to coordinate. Don't forget that, simultaneously, he has to know the possibilities of die-cutting on a Sheridan platen press, that he works with modifications of style 6 wooden boxes made from western yellow pine, and that in the same project he'll probably have to decide whether a kraft-glassine or a kraft-parchment lamination will do a better job. Don't ask him then what laminant you should use in that case—you tell him what can be done....

Available Packaging Materials—Frank J. Rubinate

The subject of available packaging materials is rather broad and undoubtedly the entire time allotted to me this evening could be devoted to reading a very tiresome list of the many materials which are on the market today. Perhaps a better and more interesting approach would be to touch briefly on the general classes of packaging materials which are being used and devote the rest of the time to an explanation of what is involved in selecting any one material or combination of materials from this large group when the packaging engineer is faced with the development of a container for any one specific item. Since my own work is most closely connected with food packaging I will talk more or less along those lines.

In general, packaging materials may be broken down into the following groups: papers, such as kraft, sulphites, coated or impregnated with various materials; plastics, such as polyethylene, pliofilm, saran, and others; metallic foils; metal cans; glass; paperboard, the types normally used for folding and setup cartons; container boards and the various types used, corrugated, solid, fiber, shipping containers; wood; textiles; adhesives; waxes; and combinations of many of the previously mentioned materials.

It would seem from the host of materials available that it is a rather simple job for the packaging engineer to reach out and select any one of the materials at will. Actual experience has taught that the selection of a material or combination of materials to package a specific item is much more difficult and must be based on consideration of several important factors.

If I may, I would like to outline the procedure which is followed in our laboratory when it becomes necessary to develop a new container, to modify an existent container or find an application for a newly developed material.

Product: Of prime importance is the knowledge of the characteristics of the item to be packaged. In food packaging, one of the factors about which we are concerned is the critical moisture content of the item. By that, we mean the amount of moisture which the product can gain or lose without affecting its quality. Tied in directly with this is the knowledge of the rate at which the item will either lose or gain moisture. An item such as soluble coffee can pick up very little moisture without deterioration. Not only must the moisture gain be retarded but the product itself is hygroscopic and will absorb moisture at a rapid rate. It is necessary, therefore, that the material used in packaging this type of item be very resistant to the passage of water vapor. On the other hand an item such as flour can absorb a relatively large amount of moisture before deteriorating, and the rate at which the product absorbs the moisture is relatively slow. This item, therefore, would not require the same amount of protection from moisture as would the soluble coffee.

Another characteristic which must be considered is the effect of oxygen on the product. Foods containing a large amount of fat are particularly susceptible to deterioration by oxidation which may be accelerated by the presence of oxygen within the container. Some items are best preserved by packaging in a vacuum or by replacing the air in the container with an inert gas such as nitrogen or carbon dioxide. The materials used for packaging these items must be capable of preserving as nearly as possible the status quo within the container. I have ignored such obvious characteristics such as whether the product is wet or dry, solid or semisolid. While the characteristics I have just mentioned are related to food, a similar process of reasoning could be applied to other items, although the specific characteristics of concern would most certainly vary.

Destination: Equally important is a knowledge of the ultimate destination of the product under consideration. The storage in a hot, humid area such as the Gulf Section of the United States, in various tropical areas of the world, or areas where extremely low temperature prevails, will most certainly have a bearing upon the selection of the packaging material.

In industry, it is possible to predict with some degree of accuracy the ultimate destination of the packaged product. In selecting materials for the packaging of supplies for the armed forces, particularly operational rations, it is impossible for the packaging engineer to obtain such information. He must, therefore, select those packaging materials which will adequately protect supplies under the most adverse conditions which can be expected. This may, at times, result in what appears to be overpackaging. Recently field tests were made on a ration designed for use in subzero areas. Here was a case where we knew the destination and designed the pack accordingly. There was no storage within the United States, yet when the ration was tested there was evidence of exposure to high temperatures. A check revealed that some of the ration had been stacked next to steam pipes in a baggage car. Unfortunately, at the present time no solution to this problem is in sight. I assure you that all of us concerned with packaging supplies for the armed services would be very happy if this condition did not exist.

Storage: Directly connected with consideration of ultimate destination of the product is a consideration of the length of time which the packaged item is expected to be stored in any given area. The longer the time of storage and the more adverse the storage conditions the better the packaging required. Again, where Army supplies are concerned, this information is not available. We try to select a packaging material which will protect the product for a period of 2 years or more. This is particularly true in packaging of food.

Handling: The next item to be considered is the type of handling and shipment which we may expect. Again, packaging men in industry are able to gather some data along these lines. Knowing the destination of the item it is possible to determine whether truck, trail, or water shipment is anticipated and a material suitable for shipment under the expected conditions can be selected. There are, of course, exceptions to this rule. Again, in considering shipment of supplies for the armed forces, the packaging man does not have this information. When he writes a specification he is never sure whether the item he is packaging, even for domestic shipment, will be shipped by truck, or by rail, and if by rail, whether the size of any one procurement will warrant full carload shipment or LCL. As far as handling is concerned, he must plan on several times more handling of Army supplies than supplies shipped commercially. Occasionally, supplies will be shipped directly from the contractor to a using installation. More often, the supplies will be shipped to a depot where they must be unloaded, stacked, reloaded, and shipped to possibly a filler depot and then to a using agency or they may be shipped directly from the first depot to ultimate destination. Very often, it becomes necessary to relocate supplies within the depot. This, of course, means additional handling. As far as overseas shipments are concerned, we can and do expect the worst rough handling. This is not based on any laboratory theory but on sad experiences during World War II. Most of you here are familiar with what we went through at that time. Speed, overcrowded storage facilities, inexperienced help, all contributed to hazardous conditions.

Equipment: We must go beyond a study of the product and shipping conditions and consider the types of equipment available for manufacturing the container from the material which is selected and the type of filling, closing, and handling equipment in the plant of the manufacturer of the item to be packaged. Again, I would like to draw a parallel between the problem of the packaging man in industry and the packaging man concerned with armed forces supplies. When working for any particular company, it is relatively simple to obtain detailed information on the equipment available within the plant or plants owned by the company. In writing packaging requirements into the government specification the material which is specified must be such that it is adaptable to the equipment available in the plants of all manufacturers who may wish to bid on government contracts. These plants may be scattered throughout the country. Before the packaging requirement is written into the specification, we must be assured that we are not restricting competition by eliminating possible sources of supply through restrictive packaging requirements. This, I believe, is one of our most important jobs. At times we have had to sacrifice a protective quality in our package because the industry concerned did not have the proper equipment to accomplish our end. Their method of packaging was quite adequate for normal commercial handling and storage and there was no need to go beyond that. At other times it has happened that companies normally use one type of container and cannot change over. A company normally packing in a metal

Frank J. Rubinate, Chief, Subsistence Packaging and Packing Division, Container Laboratories, Quartermaster Food and Container Institute.

can does not always have equipment for packing small envelopes. In some cases the problem is solved by having another company do the packing under a subcontract.

Cost: It is extremely important that we keep in mind cost factors. In selecting a material, our aim is to obtain the most economical material which will be adequate for the purpose intended. Unfortunately, because of the high degree of protection which is necessary for overseas shipment of supplies for the armed forces a good many of the low cost materials which are being used commercially are unsuitable. This requires the use of materials of a higher cost. But even though we may be working in a higher cost bracket, the principle of "the most for the least cost" still prevails.

Eye Appeal: An item of concern to the commercial packager, but not particularly important from our standpoint, is eye appeal. An attractive package can help tremendously in selling an item to the consumer. We, of course, except in our commissaries and PX's are not faced with this problem. Our chief concern is to get the supplies to the troops in the best possible condition.

Having considered at least those points which I have just mentioned, the packaging engineer is in a position to evaluate the packaging materials which are available, knowing of course, the characteristics of each of the packaging materials. Usually the field of available materials can be narrowed, making a detailed analysis of the huge number of materials available unnecessary. Having narrowed the field, the packaging engineer's next responsibility is to investigate the availability of those materials which he feels will serve his purpose. I don't think that anyone has to be reminded of this step. However, I do feel that all of us should go beyond consideration of the sources of supply and availability of the packaging materials at the time the material is selected. It is extremely important that we look ahead and plan for emergency situations when the basic materials normally used for packaging may be required for other purposes or when normal sources of supply of basic material are cut off. In our laboratories we are very conscious of the importance of this fact and have been working since the end of World War II to find substitutes for those items which we feel might be in short supply. In some instances, we have been successful. In other instances, we have not yet succeeded in finding suitable substitutes, but the laboratory, at the present time, is doing all within its power to accelerate this program. My own experience during the last two months, has indicated that at the present time there is hardly any material which is not critical. In these times we must be extremely careful to avoid getting panicky to the point where we let down the bars completely and permit the use of any substitute material. Indiscriminate use of substitute materials can be a dangerous and costly practice, both in the packaging of commercial items as well as the special items for use by the armed forces. We have gained little if we have met a delivery schedule only by down grading our packaging requirements to the point where we suffer huge losses when the items are delivered to their destination. It can be very frustrating and damaging to morale to have supplies arrive at a critical area and upon opening the shipping containers find that they are useless. However, if the packaging engineer has gone through a process similar to the one which I have outlined in his original selection of packaging materials, he will be in a better position to make a rapid evaluation of substitute materials, and he will know just which factors he can sacrifice. He will know whether he can sacrifice strength, waterproofness, or some other feature. If he has studied all factors carefully and knows the product that he is packaging it is possible many times to modify the product itself in order to safely take advantage of substitute materials.

R. E. Boedeker

Lake Erie

Sixty-one members and guests were on hand at the first meeting of the season of the Lake Erie Paper Makers and Converters Association on Friday night, October 20 at the Hickory Grill in Cleveland. Howard Coughlin, instructor in quality control at Fenn College and Quality Control Engineer of the Thompson Products Co., presented a very interesting talk on Statistical Quality Control.

A short business meeting preceeded the speaker at which time the Auditing Committee presented their report on the financial status of the group. The Constitution Committee announced that their newly drafted constitution had been found suitable for the organization and that copies would be mailed to the membership for their consideration before submitting the constitution to a vote at the next meeting.

Mr. Coughlin drew from his experience in statistical quality control with the Thompson Products Co. of Cleveland in presenting some of the basic fundamentals of the application of statistical methods to process control. Mr. Coughlin's talk traced the development of statistical quality control back to the early 1920's when W. A. Shewhart of the Bell Telephone Laboratories developed statistical methods for controlling the quality of products manufactured by The Western Electric Shops. Present statistical quality control is guided by the American Society for Quality Control with its 43 sections throughout the United States and a bi-monthly publication issued by the Society entitled "Industrial Quality Control." The society is active in stimulating interest in the advancement and diffusion of knowledge of the science of quality control and its application to industry.

Left to right: A. E. Scharfetter, H. Coughlin, L. K. Burnett, C. P. Spring, M. Zales, and A. W. Cheely

Mr. Coughlin went on to state that too often opinion has been expressed that statistical quality control's purpose is to reduce inspection costs while its real purpose is to control quality with statistical aids with the most common byproducts being reduced scrap and rework, systematized inspection procedure and higher productivity. These normally result in savings due to improvement in quality in the manufacturing process.

The use of control charts of various types was discussed as one of the tools available to depict product quality variations over a period of time in such a manner as to show the adverse variations as distinguished from normally expected variation. The control chart becomes a tool which informs the manufacturer when to adjust his process and when to leave it alone.

It was brought out that one of statistical quality control's most valuable contributions has been the development of statistical sampling acceptance plans which basically set up an inspection system which will guarantee the manufacturer's per cent defective limit to a value which is acceptable to the customer.

Mr. Coughlin summarized his talk by discussing quality level reports to management, engineering manufacturing and inspection. These reports serve as a guide in the application of control charts and provide an over-all evaluation of product quality. One of the suggested effective uses for the quality level report is to indicate to management, corrective action for abnormal adverse variation when the report is submitted. Quality level reports then become a guide to management by indicating normal and abnormal quality variations so that corrective action could be taken when necessary.

Following the talk a question and answer period was held with Mr. Coughlin acting as moderator, and the following sitting as a panel to answer questions: Walter Wilks, General Superintendent, Chase Bag Co.; Mike Zales, Production Manager, Great Lakes Box Co.; A. E. Scharfetter, Quality Control, American Greeting Publishers Co.; A. W. Cheely, Quality Control Manager, Hankins Container Co.; and L. K. Burnett, Quality Control Manager, Ohio Boxboard Co. Participation in the discussion period indicated a lively interest in the subject. Several of the panel members discussed their quality control methods and stated their interest in statistical quality control.

Chairman Burnett read a letter from T. A. Pascoe, Chairman of the Tappi Committee on Statistical Methods, outlining aid which could be furnished by the Committee on problems concerned with statistical quality control.

"Gravure Printing" was the subject of the November 17 meeting with Frank B. Johnson of the Intag Division of the Interchemical Corporation discussing the subject from an inkmaker's viewpoint and Joseph Martin of the Champlain Co., Inc., handling the press manufacturer's aspect of the subject.

R. L. Lewis

Maine-New Hampshire

The fall meeting of the Maine-New Hampshire Section was held at Colby College, Waterville, Me. on Oct. 13 and 14, 1950.

Friday afternoon a very interesting dedication service of the new Keyes Science Building on Colby College Campus was held. Following the dedication, there was a tour of inspection of the new building.

The Maine-New Hampshire Section of TAPPI then adjourned to the Women's Union Building where their meeting was held.

The following papers were presented on "The Bleaching of Groundwood Pulp."

Dr. J. S. Reichert, Manager, Peroxygen Products Development, E. I. Du Pont de Nemours & Co., Niagara Falls, N. Y.
George V. Rittenhouse, Virginia Smelting Co., New York.
Fred R. Sheldon, Buffalo Electro Chemical Co., Buffalo, N. Y.

On Friday evening a banquet was held at which R. G. Macdonald, Secretary of TAPPI, was the speaker. The Colby College Glee Club sang several selections.

The Saturday forenoon session was given entirely to mill inspections. The following mills were visited: the groundwood bleaching plant of the Hollingsworth & Whitney Co. at Madison, Me.; the Great Northern Paper Co. at Madison, Me.; the Keyes Fibre Co. at Waterville, Me.; and the Hollingsworth & Whitney Co. mill at Waterville, Me.

Following is the talk given by Mr. Rittenhouse. The other papers will be published later:

Groundwood Bleaching with Zinc Hydrosulphite

The use of zinc hydrosulphite for bleaching groundwood pulp is a pacific coast development. The type of wood used for the manufacture of newsprint on the west coast is considerably darker than most eastern or mid-western woods. These are namely the western hemlock and balsam fir varieties. In order for the western mills to make a suitable grade of paper they had to develop a method of bleaching that would raise the brightness of their groundwood pulp. This first work was done by Dr. Hirshkind of the Great Western Electro Chemical Co. Many of the western newsprint mills are using zinc hydrosulphite successfully today. The methods used on the west coast are generally covered in a paper presented by Harry Andrews of the Powell River Co. This paper was presented to the Maine-New Hampshire section of TAPPI two years ago at Poland Springs, so I shall not repeat material with which most of you are familiar.

This paper will deal mostly with the recent work that has been developed on the bleaching of groundwood pulp with zinc hydrosulphite and a limited comparison with other types of bleaching methods.

The basic problem involved in bleaching is the destruction and removal of natural color compounds that are present in wood. There are two ways in which to attack these colors.

No. 1—we can treat the wood pulp with a strong oxidizing agent and destroy many of the color compounds. This method is covered in the peroxide system of bleaching groundwood.

No. 2—we can treat these colors with a strong reducing agent and render many of them colorless. This is the zinc hydrosulphite method of bleaching groundwood.

The application of zinc hydrosulphite to this problem of bleaching is relatively simple. With the control of certain variables, we can predict what bleaching action can be obtained with zinc hydrosulphite. The recommended method as developed by the Virginia Smelting Co. is as follows: first, the temperature of the stock should be around 140°F.; the consistency between 3 and 5%; the pH of the stock should be in the range of 4.5–6.5. No critical pH point within this range has been found. The most important step in the process is to give the stock enough quiet retention at the required temperature. There should be at least 15–20 minutes retention before the pulp is used. This retention time is necessary in order to allow the reducing action of the hydrosulphite to completely and permanently destroy the reducible colors. If we did not have this quiet retention, the colors present in the pulp would not be completely reduced and the chance for color reversion would be increased. The use of this retention period forestalls any chance for color reversion.

The zinc hydrosulphite is added when the proper temperature is reached. The pulp is agitated only enough to insure mixing of the hydrosulphite. The recommended amount of chemical to use is 1% or 20 lb. of zinc hydrosulphite powder per ton of pulp.

The following are results of laboratory bleaches on spruce groundwood pulp:

	ZnS_2O_4, %	Temperature, °F.	pH	Retention time, min.	Brightness	Point gain	Cost per ton
1	0	140	5.5	20	61	...	..
2	.5	140	5.5	20	65	4	1.83
3	1	140	5.5	20	67.5	6.5	3.65
4	1.5	140	5.5	20	69	8	5.49

The results obtained above can be duplicated with constant accuracy. This indicates that constant results may be obtained in the plant if control conditions are kept in line.

More appropriate to this group would be the following results obtained in actual plant practice. These data were obtained from a mill that has been using zinc hydrosulphite for the last two years.

Zn_2SO_4, %	Temperature °F.	pH	Retention, time, min.	Brightness	Point gain	Cost per ton
0	145	5.5–6	..	58.8	..	..
1	145	5.5–6	30	66.0	7.2	3.65
2	145	5.5–6	30	67.5	8.7	7.30

These data show that most of the colors are reduced by the action of the recommended 1%. It becomes costly when the percentage of zinc hydrosulphite goes over 1%. The cost is doubled for the extra point and a half.

No mention has been made so far as to the merits of the zinc hydrosulphite bleach as compared to the oxidizing type bleaches.

The oxidizing type bleach, depending on the consistency of the pulp, is reported to give an increase in brightness of from 9 to 12 points using 2% bleaching chemical at a chemical cost of roughly $10 per ton of pulp treated. There is usually a considerable expenditure for new equipment to handle the process.

The zinc hydrosulphite bleach at the recommended conditions has been shown to give around 7 points gain in brightness at 1% bleaching chemical. This cost would be $3.65 for chemicals per ton of pulp. That means a cost of 53 cents per point of brightness gain per ton of pulp. Assuming a 12 point gain for oxidizing bleaches at a chemical cost of $10 per ton we would pay 83 cents per point of brightness gain per ton of pulp.

I have a set of data obtained from a mill which has used peroxide for over two years where they tried zinc hydrosulphite to compare it with their peroxide system.

The tests were run on spruce groundwood at an initial brightness of 61.9 G.E.

The bleaching conditions for zinc hydrosulphite method were: temperature 143°F.; pH 7; consistency 3.7%; per cent zinc hydro used 1.9. Total retention time—1 hour.

The bleaching conditions for the peroxide method were the standard method using 2.5% Na_2O_2.

Samples taken at approximately one hour intervals showed:

	Groundwood sample Brightness GE		Machine paper (50% groundwood 50% sulphite 80 brightness) Brightness GE	
	ZnS_2O_4	Na_2O_2	ZnS_2O_4	Na_2O_2
1	69.2	71.8	71.4	72.6
2	69.6	71.6	70.8	72.8
3	69.2	72.1	71.0	73.5
4	69.9	71.0	70.8	73.1
5	69.5	71.6	71.0	73.0

2.1 Average point difference in favor, 2 of peroxide

These data show that the zinc hydrosulphite bleach does not reach the higher brightnesses obtained by the peroxide method. It does show that if your pulp does not require the higher ranges of brightness, the zinc hydrosulphite method could be utilized to advantage.

There are other methods of applying zinc hydrosulphite successfully. The foregoing is to the best of our knowledge the most efficient method of use.

H. E. Pratt

Empire State

Eastern New York District

The first regular monthly meeting of the Eastern District of the Empire State Section was held on October 19 at Milfranks' Restaurant at Glens Falls, N. Y., with Robert Moynihan presiding.

The program for the evening was a joint presentation on the general subject, "Trends in European Paper Making," by Vance P. Edwardes, consultant of Corinth, N. Y., and Foster P. Doane of the Sandy Hill Iron and Brass Works of Hudson Falls, N. Y.

Mr. Edwardes recently visited several paper mills in Austria as a member of a government team of experts who made a study of the paper industry in Austria for the Economic Cooperation Administration. Mr. Edwardes' address is attached herewith.

Mr. Doane likewise went to Europe and visited paper mills in Austria, as well as mills in Italy and France. He supplemented Mr. Edwardes' talk and showed pictures taken on the trip abroad.

Mr. Edwardes remarks follow:

The program of the Economic Cooperation Administration under the Marshall Plan for aid to war damaged countries in Europe has, as one of its many objects, the rebuilding of the Austrian Pulp and Paper Industry. Austrian economy had never fully recovered from the effects of the first world war which resulted in the dissolution of the Austrian-Hungarian monarchy with all of the attending political and economic disturbances. Austria was reduced to a country of about 7,000,000 people, nearly 2,000,000 being concentrated in Vienna.

About 1935, Austrian industry started to rebuild but in 1938 Hitler occupied the country and all paper mill improvements were stopped, with the result that the mills are even now practically in the same physical and technological position they were in the 20's. Paper machines are small and slow, the widest is 125 inches, traveling at 700 feet a minute and producing newsprint. Of the 84 mills, only 13 have a production of 50 tons a day. E.C.A. credit of about $30,000,000 is to be extended to 29 mills only, and of these the 13 larger and more important are allotted over 90% of the total credits.

Because of the present high taxes on profits (approximately 75%) the mills are able to self finance to the extent of only 30%, that is, the E.C.A. credits represent 70% of the total planned investment. In general, of the monies advanced by E.C.A. about 40% is to be used to purchase U. S. equipment and the rest in various European countries, in part on a barter basis. Usually, equipment from this country is higher priced than that manufactured in Europe. The program calls for the repayment of the E.C.A. loan in ten years but whether this can be met, depends on many considerations beyond the power of the industry to control. However, if no untoward events occur, the savings made, as outlined in the program, will practically enable the retirement of the loan as planned.

From the American point of view, the proper approach to the problem would be to shut down many of the small mills and build a new larger modern mill. This, however, is out of the question for several reasons, the most important of which is political. The mills are often located in isolated communities and to throw those workers out of employment would add recruits to the Communist Party, which, while it amounts to only 4 to 5% of the voters, is a well-organized pressure group.

Paper production in the years immediately following World War II was almost nonexistent but by 1949 had increased tremendously, in fact, to only 28% less than prewar. By 1952, when the Marshall Plan aid expires, the anticipated production will be 20% over prewar and 58.5% over 1949, or 869,000 tons. This will be accomplished at an estimated savings of 15% in manufacturing costs brought about by increased production per worker and technical savings. In comparison with the U. S. the paper and board consumption in 1949 was 55 pounds per capita which by 1952 should reach 78 pounds whereas in this country, the per capita consumption is 360 pounds.

There is only one kraft mill in Austria although another is contemplated and needed. But little use is made of board containers and the utilization of pine and sawmill waste offers an excellent opportunity for forest conservation. Because of the many small mills and high production costs, the industry is highly specialized and quality rather than quantity minded. Of the total estimated 1953 production of paper and board, 33% will be writing, book, and specialties. This division appears logical particularly if the proposal to remove the trade barriers among European countries becomes a fact.

Since the paper machine capacity is about 65% of the pulp capacity, sulphite must be exported and compete in the world markets. Many special grades of pulp are produced, including rayon but the quality is not always uniform. Improvements will have to be made through technical control and costs reduced before the industry is on a sound footing. Many sulphite mills have alcohol plants and because of the seriousness of stream pollution and high steam costs, a number are planning to install waste liquor plants.

Wages are low and although much higher than prewar, living costs have increased more rapidly. For example, an hour's work will buy 5 eggs, one haircut, half gallon of gasoline or four pounds of bread. Because of the low wage rate, industry cannot afford to spend over the equivalent of $5000 in order to save one man per shift. It would require all the salary of a technical man for two years to buy an automobile, therefore, bicycles are as common as motor cars in this country. Most of the people have lost their savings and life insurance twice since the first World War and many professional men are starting their careers for the third time. However, it was very noticeable that there was no complaining or whining. The Austrians are a clean, healthy, industrious people, friendly, with a good sense of humor, eager for help, and very appreciative.

Robert B. Blakeslee

Northern New York District

On October 12, the Northern New York District of the Empire State Section met at the Hotel Woodruff in Watertown for dinner and a discussion of the Research Facilities at the State College of Forestry in Syracuse, as presented by Prof. F. W. O'Neil. About 90 attended the dinner preceding the meeting which was opened by the Chairman, Harold Spector of the St. Regis Paper Co. Prof. O'Neil's descriptions of the various laboratories used in their research work at the college were supplemented by numerous slides. The discussion after Mr. O'Neil's talk follows:

Question: Your study of penetration indicated that 85% of the poplar was affected—is that also true of the beech or maple?

Answer: We were able to get satisfactory penetration with the beech and maple—which indicated they were not ffected to the same extent at least.

Question: Does the penetration occur down the sides of the fibers?

Answer: No, right through the vessels themselves.

Question: Could you force penetration by the use of pressure?

Answer: No, we tried that and also by cutting the wood—maybe this is one of the causes of shives in pulp.

Question: Would there be any advantage in going to extreme vacuum?

Answer: I do not know. It would be quite a job. We have gone to 28 atmosphere air pressure, and now we are trying to go as low as possible. It may be that you would get better penetration if you went to absolute vacuum.

Question: How much color degradation do you get with the infected wood?

Answer: About the same color difference as in the untreated wood. If you separate the aspen, you will get between 60 and 67 brightness in the good parts, but if you use the affected parts in a large proportion, you might get as low as 50 brightness.

Question: Do you have much trouble with this infection invading your own tree farm?

Answer: The 28-year old Hybrid poplar we have on the farm does not seem susceptible to the disease. It may possibly be a natural result of growing old, because aspen is not a long-lived tree.

Question: Would you get better penetration by using chips?

Answer: It would increase the rate of penetration, but that would be taking it out of the mechanical field.

Question: What sort of grinding face did you use?

Answer: We have tried various stone faces and a wide range in grit, and all produced pulps of good quality.

Question: Does it take more work to get the apparent density down over the ordinary type of groundwood pulp?

Answer: One thing you can do with this pulp that cannot be done with the regular groundwood—that is, treat it afterward in the refiners and increase your strength tests.

The Northern New York group of the Empire State Section met at the Hotel Woodruff, Watertown, N. Y. on November 9 for dinner and its monthly meeting. The Chairman of the Group, H. Spector, introduced the speaker H. D. Cook, of the Sweet Brothers Paper Co., Phoenix, N. Y. Dr. Cook announced that his talk would have nothing to do with papermaking, but was intended to be an entertaining description of what he saw on his recent trip to South Africa and Brazil. Although he had visited several paper mills on business, the only pictures of a paper mill were those taken at the mill where W. O. Hisey, former professor of papermaking at Syracuse State College of Forestry, is now located in South Africa. Dr. Cook showed a hundred slides of colored photographs taken during his journey and commented on his observations of life in those countries visited.

The December meeting was held on the 14th. George Fromm and Harold Sinclair of the American Cyanamid Co. discussed the practical aspects of the application of wax sizes in paper manufacturing.

Lake States

The Lake States Section met at the Northland Hotel Green Bay, Wis., on Tuesday, November 14. H. C. Crandall of the Mosinee Mills, Mosinee, Wis., presided as Chairman. About 200 were present.

At 1:00 p.m. a large number of members and guests visited the mill of the Green Bay Pulp and Paper Company where the new semichemical pulp and corrugating paper operations were observed.

At 2:00 p.m. a symposium on "Semichemical Pulp and Paper," was held during which talks on semichemical pulping were given by Karl Fries, Rhinelander, Wis., W. W. Marteny and K. E. Olsen, National Container Corp., Tomahawk, Wis., and S. R. Parsons, Consolidated Water Power and Paper Co., Wisconsin Rapids, Wis.

Following the dinner R. G. Macdonald, Secretary of TAPPI and several executives of Wisconsin mills were introduced by Mr. Crandall. The speaker of the evening was A. Newell Rumpf, Vice-President of the Harris Trust and Savings Bank, Chicago, Ill., who talked on "A Banker Looks at Paper Company Financing."

The papers presented at this meeting will be published in a later issue of *Tappi.*

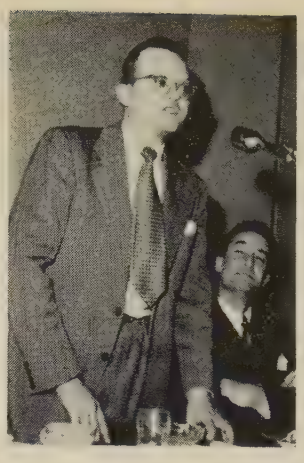
Ohio

The Ohio Section celebrated its fifteenth anniversary at its November 9 meeting at the Manchester Hotel in Middletown. The meeting was held in honor of the past chairman of the Ohio Section who contributed so greatly to the sound growth of the organization. Starting as a small group of interested members on Oct. 19, 1935, the Ohio Section has grown to a membership of 330 with an average meeting attendance in 1949–50 of over 100.

Of the ten past-chairmen eight were present at the meeting, some having come from such distances as Atlanta, Ga. and Houston, Tex. An attractive Souvenir Booklet detailing the history and activities of the Ohio Section was distributed to the members in attendance.

Don Goodman, present chairman of the Ohio Section of TAPPI introduced R. G. Macdonald, National Secretary of TAPPI. Mr. Macdonald briefly traced the history and events leading to the formation of the Ohio Section. He lauded the energy and enthusiasm shown by the association and gave advice for successful and worth-while meetings.

Mr. Macdonald stressed the importance of keeping the present high quality of the publications of the National organization. These publications include the monthly magazine, the TAPPI Standards, the TAPPI Data Sheets, the Bibliographies of Paper Making, and monographs on selected subjects. All of these publications are of high caliber and much work and constant checking is performed to keep them so. Mr. Macdonald pointed out that the local sections can greatly aid the National Association by submitting papers for publication, contributing to the data sheets, or by such group effort as sponsoring a national committee, or testing method. Many members of the local sections have much of value to offer, and the life of the National Association depends on these members contributing of their time and ideas.



D. J. Goodman, Sorg Paper Co., Chairman Ohio Section, and H. T. Randall

V. F. Waters, Southern Pulp & Paper Manufacturer, First Chairman, Ohio Section

Following Mr. Macdonald's talk, fountain pen sets were presented to the past-chairman in appreciation for their faithful service to TAPPI. Vincent F. Waters, first chairman of the Ohio Section made the presentations to the following past-chairmen.

H. H. Latimer	1938–1939
J. E. Burdsall	1940–1941
Harry C. Fisher	1941–1942
Carl D. Roess	1942–1946
Samuel R. Olsen	1946–1947
Philip S. Cade	1948–1949
Arthur Thurn	1949–1950

Two other past-chairmen receiving the tokens, but unable to attend the meeting, were K. P. Geohegan, 1939–1940, and D. M. Yost, 1947–1948. A letter from Mr. Geohegan expressing his regret that he was unable to attend was read to the TAPPI men by Chairman Goodman, and a rousing round of applause was given for Ken Geohegan's good fellowship and tireless efforts in behalf of the Ohio Section of TAPPI.

Mr. Goodman read messages of good will from the Michigan and Lake Erie Sections of TAPPI

D. J. Goodman, R. G. Macdonald, Arthur Thurn, and H. H. Latimer

Left to right: P. S. Cade, Arthur Thurn, S. I. Olsen, H. H. Latimer, R. G. Macdonald, H. T. Randall, D. J. Goodman, and V. F. Waters

The speaking program featured an informal talk by H. T. Randall, Vice-President of the Champion Paper and Fibre Co. Mr. Randall gave the group a very interesting account of his recent trip to England, Scotland, and the Scandinavian countries. During the recent trip, Mr. Randall visited 21 pulp and paper mills, 7 large laboratories, 3 machinery manufacturers, and 7 clay mines. The trip included over 5000 miles of driving. Mr. Randall told of his impressions of the pulp and paper industry in Scandinavia, and briefly sketched some of his observations on the economic problems facing the industry in Britain and on the Continent.

The meeting was attended by 122 members and guests of the Ohio Section.

New England

A. E. Bachmann, President of TAPPI and Vice-President, Missisquoi Corp., Sheldon Springs, Vt., was the speaker at the November meeting of the New England Section of TAPPI which was held at the Hotel Roger Smith, Holyoke, Mass. on November 17.

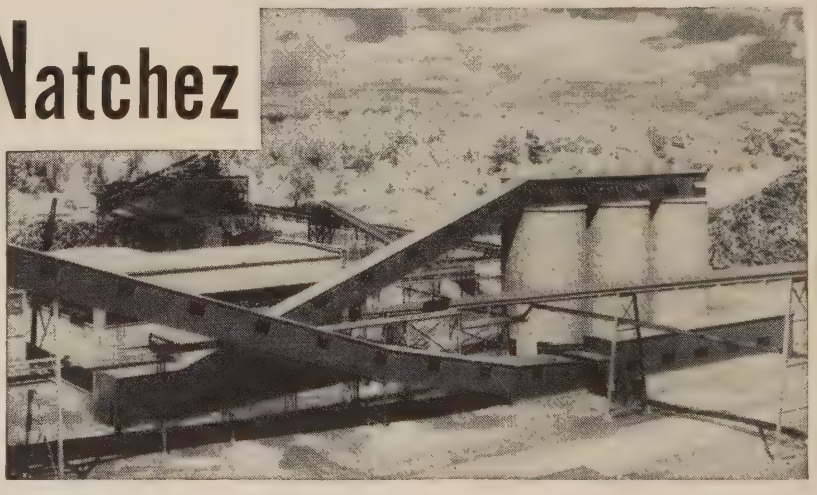
Mr. Bachmann had as his subject "Operating Principles as Related to Quality Control." This was the first in a series of meetings which will be devoted to the various aspects of quality control in the manufacture and converting of paper that are planned for this year.

The speakers table at the November meeting of the New England Section of TAPPI. Left to right: J. Bainbridge, S. Quattrocchi, F. Klein, Miss Helen Kiely, R. J. Proctor, A. E. Bachmann, H. Brawn, G. Benson, and Miss Ann M. Brown

Quality control is probably the most important single problem in paper manufacture because it is a necessary precedent to all the various cost controls such as waste control, production control, cost control, and budgetary control. It forms essentially the first basic step in cost control. Without an effective system of quality control it is quite useless to consider making any cost reduction in the form of increased speeds or elimination of excess materials.

It is expected that Mr. Bachmann's talk will be published in the January, 1951 issue of *Tappi*.

Stebbins at Natchez



WHEN the International Paper Company's new Southern Kraft Division mill began operation at Natchez, Mississippi, three large silos built of Stebbins reinforced Semtile construction were ready for storing the southern hardwood chips for processing into pulp.

Also the digesters had been lined with Stebbins thin carbon brick linings for complete corrosion resistance.

The low density bleach towers, washer vats, and many other tanks are Stebbins Semtile construction while all tile lined chests and towers have Stebbins Semplate linings to assure long life and clean, trouble-free operation.

SEMCO

Stebbins Engineering and Manufacturing Company

WATERTOWN, NEW YORK

CANADIAN STEBBINS ENG. & MFG. CO., LTD. — CASTLE BLDG., MONTREAL, CANADA

STEBBINS ENGINEERING CORP. — TEXTILE TOWER, SEATTLE, WASH.

UNITED STATES PATENTS ON PAPERMAKING

Third Quarter, 1950

Compiled by CLARENCE J. WEST

The following list of patents has been compiled from the current numbers of the Official Gazette of the United States Patent Office. Because, as a rule, only one claim is published in the Gazette, it is not claimed that the list is complete; also, it is possible that the list may contain some patents that do not apply specifically to pulp and paper manufacture.

Copies of any of the following patents can be obtained from the United States Patent Office, Washington 25, D. C., by sending twenty-five cents for each patent desired.

July 4, 1950

2,513,344. Method of bleaching high-density pulp. Robert L. McEwen, assignor to Buffalo Electro-Chemical Company, Inc., Tonawanda, N. Y. Filed Sept. 19, 1946. 6 claims. (Cl. 8-104.) A wet lap of groundwood pulp is treated with an alkaline peroxide solution, disintegrated, and allowed to bleach in the moist condition.

2,513,394. Apparatus for coating paper. William H. Barrett and Bernard K. Asdell, assignors to Minnesota and Ontario Paper Company, Minneapolis, Minn. Filed May 24, 1945. 7 claims. (Cl. 91-49.) The fountain, the applicator, and the metering rolls form a coating container.

2,513,495. Bottle carrier. Charles F. Koerber, Clay Township, St. Joseph County, Ind. Filed April 11, 1949. 12 claims. (Cl. 224-45.) A portable bottle cooler or refrigerator.

2,513,647. Taping means for carton folders. Robert R. Hundley, assignor to Old Dominion Box Company, Lynchburg, Va. Filed June 28, 1948. 2 claims. (Cl. 93-56.) A taping mechanism is used in conjunction with a carton-folding machine.

2,513,708. Method of proofing laminated material. Daniel Belcher, assignor to Bemis Bros. Bag Company, St. Louis, Mo. Filed Nov. 12, 1943. 3 claims. (Cl. 154-138.) An apparatus is described for impregnating a web with an amorphous or crystalline wax.

2,513,762. Article carrier. James D. Tyson, Jr., assignor to Tyson-Caffey Corporation, Carthage, N. C. Filed April 6, 1948. 2 claims. (Cl. 224-48.) A cardboard carrier is designed for soft drink cups or ice cream cones.

2,513,787. Bleaching treatment for cellulosic materials. George A. Day and Benjamin G. Hoos, assignors to Brown Company, Berlin, N. H. Filed Jan. 31, 1947. 6 claims. (Cl. 8-105.) Pulp is bleached with a mixture of hypochlorite and chlorite, first at a pH of 9 or above and then at a pH below 5.

2,513,788. Bleaching of sulfate wood pulp. George A. Day and Benjamin G. Hoos, assignors to Brown Company, Berlin, N. H. Filed Jan. 31, 1947. 1 claim. (Cl. 8-106.) Sulphate pulp is treated successively, without intervening washing, with hypochlorite and chlorine (the hypochlorite represents 20–50% of the total equivalent chlorine input), digested with sodium hydroxide at 140–210°F., and then treated with chlorine dioxide at 140°F. or above, a stock consistency of 4%, and a pH of 5 to 7.

2,513,902. Carton. Walter J. Tyrseck, assignor to Robertson Paper Box Co., Inc., Montville, Conn. Filed Nov. 30, 1948. 4 claims. (Cl. 229-14.) A shockproof or cushioned receptacle for bottles or the like.

2,514,021. Composition board. Herbert Abraham, assignor to The Ruberoid Co., New York, N. Y. Filed March 13, 1948. 5 claims. (Cl. 106-93.) The board contains 86.5% portland cement, 3.5% asbestos fiber, 7% sulphate pulp, and 3% asphalt.

2,514,073. Waterproof flexible folding container. Karl R. Karlson, assignor to Reynolds Metals Company, Richmond, Va. Filed Nov. 16, 1945. 1 claim. (Cl. 220-26.) A folding waterproof container is made from a unitary, unnotched, seamless, flexible sheet, such as laminated kraft paper which may be bonded with a waterproof adhesive, a laminated foil and paper, or a waterproof fabric.

2,514,159. Apparatus for screening fibrous suspensions. Nils W. Jönsson, Lidingo, Sweden. Filed May 3, 1945. 2 claims. (Cl. 92-35.) The screen is rotated to subject the fibers to a centrifugal motion; simultaneously, the stock is moved from the outside inwardly.

2,514,240. Differential drive. Lloyd Hornbostel, assignor to Beloit Iron Works, Beloit, Wis. Filed May 27, 1946. 3 claims. (Cl. 74-675.) The transmission of power from a main line shaft to any of the rotating sections of a papermaking machine is accomplished without the use of an adjustable pulley and belt arrangement.

2,514,252. Bottle carrier. Harry E. Mueller, Salem, Ill. Filed May 31, 1946. 1 claim. (Cl. 294-87.22.) A cardboard carrier for milk or beverage bottles.

2,514,295. Cushioned packing box. Stephen Scurich, Jr, Watsonville, Calif. Filed Nov. 27, 1948. 5 claims. (Cl. 229-6.) A fruit packing box.

July 11, 1950

2,514,381. Folding box. Herman A. Feigelman, Paterson N. J. Filed July 11, 1946. 9 claims. (Cl. 229-27.) A collapsible carton for pencils and the like.

2,514,384. Carton. William P. Frankenstein, Cincinnati, Ohio. Filed May 7, 1945. 8 claims. (Cl. 229-32.) A knockdown carton and its lids are provided with flanges which extend beyond the carton walls at the base of the carton and at the upper end of the lid.

2,514,389. Polymerizable styrene-tall oil modified polyester composition. Sanford E. Glick, assignor to Monsanto Chemical Company, St. Louis, Mo. Filed Nov. 16, 1944. 10 claims. (Cl. 260-22.) Details are given of the preparation of the ester which can be used for the impregnation of paper and the like.

2,514,484. Concrete form lining. Emile Frederick, Jr., assignor to The Celotex Corporation, Chicago, Ill. Filed March 12, 1942. 7 claims. (Cl. 154-45.9) A composite concrete form-lining material consists of a sheet of insulating board lined on one side with a sheet of porous paper.

2,514,503. Method of bleaching moist felted groundwood pulp. Robert L. McEwen and Fred R. Sheldon, assignors to Buffalo Electro-Chemical Company, Inc., Buffalo, N. Y. Filed July 30, 1947. 2 claims. (Cl. 8-104.) A method of bleaching with an alkaline peroxide is described.

2,514,547. Jordan plug. Dwight E. Jones, assignor to E. D. Jones & Sons Company, Pittsfield, Mass. Filed Sept. 27, 1945. 3 claims. (Cl. 92-27.) The bars or knives of a jordan plug are supported throughout their entire length and are secured to the plug by circumferential windings of wires which are interlocked with longitudinally spaced circumferential grooves in the body of the plug.

2,514,587. Box. Eugene J. Nugent, assignor to California Container Corporation, Emeryville, Calif. Filed Jan. 18, 1945. 5 claims. (Cl. 229-31.) The end walls and the adjacent portions of the side walls of a corrugated box are reinforced to sustain heavy stacking loads.

2,514,689. Sized paper. Robert N. Woodward, assignor to Eastman Kodak Company, Rochester, N. Y. Filed Nov. 7, 1946. 3 claims. (Cl. 117-155.) A paper for photographic purposes is sized with a mixture of 1–8% starch solution, 10–50% (based on the starch) of a melamine-formaldehyde resin, and citric acid to produce a pH of 3–5.

2,514,801. Paper crimper and stacker. Gerald G. Sapp, Damascus, Va. Filed Sept. 13, 1948. 15 claims. (Cl. 154-30.)

2,514,833. Corner protector for enclosed bodies. Ernest J. Bergeron, Fitchburg, Mass. Filed Jan. 26, 1948. 6 claims. (Cl. 229-1.5.) A protective corner unit for bodies within a container may be folded into protector form from a blank of single-wall corrugated paperboard.

2,514,954. Surface active composition and method of making. James M. Johnson, Francis L. Mark, and Murray Jelling, Brooklyn, N. Y., assignors to Nostrip Inc. Filed Oct. 31, 1947. 8 claims. (Cl. 260-102.) An amidoaminoamine soap is formed from a polyamine and tall oil or other rosin or fatty acids.

2,515,026. Carton. Robert Van Rosen, New York, N. Y., assignor to J. Makowsky Corporation. Filed March 26,1947. 5 claims. (Cl. 229-22.) The carton has a triangular cross section.

2,515,113. Method of producing molded fiber articles. Merle P. Chaplin, assignor to Chaplin Corporation, South Portland, Maine. Filed Dec. 17, 1943. 7 claims. (Cl. 92-54.) A molded pulp egg carton incorporates a hinge as an integral part of the structure.

2,515,151. Container. Walton B. Crane, assignor to Alpak, Los Angeles, Calif. Filed Jan. 26, 1946. 2 claims. (Cl. 229-28.) The transverse partitions of a multicompartment paperboard container are automatically erected and held in position by means of a longitudinal partition.

July 18, 1950

2,515,232. Water-detecting paper and a water-detecting coating composition therefor. Morris S. Kantrowitz and Earl J.

Gosnell, Washington, D. C. Filed Dec. 31, 1946. 9 claims. (Cl. 106-171.) Paper is treated with equal amounts of finely divided Lithasol brilliant blue E and No. 3 lithographic varnish dispersed in a solution of ethylcellulose and ethyl acetate.

2,515,327. Method of making knockdown, hinged lid cartons. Samuel Bergstein, assignor to Robert M. Bergstein and Frank D. Bergstein, trustees. Filed Sept. 9, 1944. 7 claims. (Cl. 93-49.) A knockdown carton incorporates a preformed hinged lid which can be opened and reclosed readily.

2,515,340. Coated paperboard and method of making same. Harry C. Fisher and Brainard E. Sooy, assignors to The Gardner Board and Carton Co., Middletown, Ohio. Filed April 1, 1947. 18 claims. (Cl. 117-76.) An aqueous solution of one volume of 5% polyvinyl alcohol and four volumes of 6% converted starch is applied to the web on the breaker calender stack; this is followed by a mixture of 10 quarts of water, 4 parts of dry urea-formaldehyde resin, and 0.4 part of ammonium chloride.

2,515,620. Carton sealing machine. Franklin M. Willbrandt, assignor to Battle Creek Bread Wrapping Machine Company, Battle Creek, Mich. Filed Sept. 15, 1947. 4 claims. (Cl. 93-2.) A semiautomatic sealing machine is adapted for the rapid closing and sealing of food cartons and liner bags positioned within the carton.

2,515,621. Stripping mechanism for carton forming machines. Franklin M. Willbrandt, assignor to Battle Creek Bread Wrapping Machine Company, Battle Creek, Mich. Filed Jan. 26, 1948. 11 claims. (Cl. 93-36.) An arrangement permits the cartons to be stripped from the blocks without stopping the forming mechanism of the machine.

2,515,739. Method of treating tall oil. Jerry J. Smerechniak (Jerry J. Sherwood) and George W. Barlow, assignors to American Cyanamid Company, New York, N. Y. Filed March 6, 1947. 3 claims. (Cl. 260-97.7.) The oil is heated with 0.1 to 2.5% of zinc at 150 to 275°C. to improve the color and odor.

2,515,887. Display box. George A. Moore, assignor to National Biscuit Company, New York, N. Y. Filed Sept. 5, 1945. 3 claims. (Cl. 206-45.26.) The container incorporates locking means that can be engaged in one operation to form a rigid structure.

2,516,085. Container. Marshall I. Williamson, assignor to National Folding Box Company, Incorporated, New Haven, Conn. Filed Feb. 14, 1945. 8 claims. (Cl. 229-37.) A method for making and sealing a leak- and siftproof container.

July 25, 1950

2,516,124. Shipping carton for sensitive electrical instruments. Charles O. Kishibay, New York, N. Y. Filed Feb. 27, 1946. 8 claims. (Cl. 206-46.)

2,516,266. Parcel bag. William Simpson, assignor to Cohoes Envelope Company, Inc., Cohoes, N. Y. Filed May 22, 1948. 3 claims. (Cl 229-54.) A paper parcel bag is so constructed that the handle members on the front and back walls of the bags are located opposite to each other.

2,516,384. Mechanically curling of cellulose fibers. Harold S. Hill, Kenogami, and Joseph Edwards, Riverbend, Quebec, Canada. Filed Nov. 25, 1944. 6 claims. (Cl. 92-20.) This relates to the Curlator.

2,516,444. Treated paper parachute. Ralph Anzalone, assignor to Leonard P. Frieder, New York, N. Y. Filed Nov. 17, 1945. 1 claim. (Cl. 244-145.) The paper is softened with glycerin.

2,516,447. Method and apparatus for chemical treatment. Elmer R. Burling and John P. Rich, Nashua, N. H. Filed Feb. 24, 1947. 10 claims. (Cl. 8-156.) A pulp bleacher is equipped with positive radial impeller arms which move the stock radially outward and which must return radially inward.

2,516,624. Method and apparatus for forming cartons. Reynolds Guyer, assignor to Waldorf Paper Products Company, St. Paul, Minn. Filed Nov. 6, 1944. 16 claims. (Cl. 93-51.) A carton is provided with locking tabs on two opposite side walls which are designed to engage in cooperating slots on the two remaining side walls.

2,516,664. Hypochlorite bleaching of ground wood. Daniel O. Adams and George B. Hughey, assignors to West Virginia Pulp and Paper Company, New York, N. Y. Filed Oct. 16, 1944. 5 claims. (Cl. 8-105.) The tannin and color bodies are extracted with hot dilute sodium hydroxide and then bleached with alkaline hypochlorite.

2,516,700. Coating composition. Donald F. Holloway and Harland H. Young, assignors to Swift & Company, Chicago, Ill. Filed Dec. 15, 1945. 6 claims. (Cl. 106-146.) A typical composition contains 25 parts of casein, 25 parts of urea, 45 parts of water, and 1.25 parts sodium pentachlorophenate.

2,516,820. Lined cartons. John W. Wilson, assignor to The Interstate Folding Box Company, Middletown, Ohio. Filed Dec. 26, 1946. 6 claims. (Cl. 229-14.) A four-panel carton for the packaging of foodstuffs is provided with a bag-type liner.

2,516,827. Method of producing vanillin. Harry B. Marshall and Charles A. Sankey, assignors to The Ontario Paper Company Limited, Thorold, Ontario, Canada. Filed July 23, 1945. 5 claims. (Cl. 260-600.) Waste pulp liquors are heated with sodium hydroxide and cupric sulfate at about 170° for three hours.

August 1, 1950

2,516,847. Process of sizing exploded fibers. Robert M. Boehm, assignor to Masonite Corporation, Laurel, Miss. Filed Dec. 1, 1944. 4 claims. (Cl. 92-1.) A method of exploding hardwood chips and forming from the fibers a laminate suitable for switchboard panels.

2,516,884. Method of and apparatus for preparation and distribution of sizing materials. George J. Kyame, assignor to the United States of America as represented by the Secretary of Agriculture, Washington, D. C. Filed Dec. 8, 1948. 3 claims. (Cl. 127-28.) A combination of a make-up tank, a pump, and a heat exchanger is described.

2,516,978. Freezing and cooking bag. Herman Gottesman, Ramsey, N. J. Filed Sept. 27, 1946. 1 claim. (Cl. 229-55.) The bag consists of an inner porous layer of vegetable parchment and an outer airtight layer of aluminum or other metal foil.

2,517,030. Display and dispensing carton. William A. Ringler, assignor to Gardner Board and Carton Co., Middletown, Ohio. Filed June 15, 1945. 3 claims. (Cl. 211-128). The carton is so constructed that, when arranged in the display position, several tiers of shelflike supports are presented.

2,517,068. Folded-in bag valve with sleeve insert. Norman E. Weeks, assignor to Bemis Bros. Bag Company, St. Louis, Mo. Filed Sept. 8, 1947. 2 claims. (Cl. 150-9.) A valved bag incorporates a folded-in valve and a creped kraft paper valve sleeve which may be tucked in to form a tight closure after the bag is filled.

2,517,069. Laminated panel and method of making the same. Lawrence B. Weymouth, assignor to Briggs Manufacturing Company, Detroit, Mich. Filed Jan. 8, 1947. 5 claims. (Cl. 154-106.) This is a paper-base laminate suitable for the interior of automobiles.

2,517,080. Carton. Frederick B. Buhrmaster, assignor to Gaylord Container Corporation, St. Louis, Mo. Filed March 25, 1948. 3 claims. (Cl. 229-23.) A stapled fiberboard container includes multi-ply reinforcing flaps along the upper edges of its end panels.

2,517,111. Light-sensitive blueprint layer and process of producing the same. Edward Jahoda, Manhasset, N. Y. Filed Nov. 14, 1946. 3 claims. (Cl. 95-7.) The coating contains 5 parts potassium sodium hexametaphosphate, 4 parts alkali ferricyanide, and 4 parts of a weak dissociable ferrous salt.

2,517,186. Shipping container for irregular shaped articles. James A. Farrell, assignor to Cadillac Products, Inc., Detroit, Mich. Filed July 9, 1948. 5 claims. (Cl. 206-46.) Fiberboard container for various parts of an automobile.

2,517,261. Molded product. Isaac E. Veitch, Birmingham, Ala. Filed Oct. 8, 1949. 7 claims. (Cl. 260-29.4.) A molded wallboard includes blast furnace slag as a filler; the binder is sodium silicate containing some urea-formaldehyde resin.

2,517,449. Carton blank folding machine. Albert F. Shields assignor to S. & S. Corrugated Paper Machinery Co., Inc., Brooklyn, N. Y. Filed June 3, 1947. 3 claims. (Cl. 93-49.)

2,517,465. Molded pulp carton. John W. Cox, assignor to Shellmar Products Corporation, Chicago, Ill. Filed Dec. 20, 1947. 4 claims. (Cl. 229-2.5.) A cellular egg carton.

August 8, 1950

2,517,552. Container. Jacob M. Field, assignor to Deering, Milliken & Co., Inc., New York, N. Y. Filed July 25, 1946. 4 claims. (Cl. 229-39.) A hexagonal pasteboard carton.

2,517,698. Method of polymerizing fiber reinforced resinous material. Irving E. Muskat, Plainfield, N. J., assignor to Marco Chemicals, Inc. Filed March 5, 1945. 13 claims. (Cl. 117-65.) A method of forming a paper-base laminate.

2,517,724. Cushion pad and method of manufacture. Charles H. Schuh, assignor to Union Carbide and Carbon Corporation, New York, N. Y. Filed May 29, 1945. 18 claims. (Cl. 18-47.5.) The pad is formed from a slurry of palmetto pith, pulped newsprint or wood pulp, and paraffin wax.

2,517,754. Hot-melt coating composition. Arthur E. Young and Kenneth D. Bacon, assignors to The Dow Chemical Company, Midland, Mich. Filed Nov. 13, 1945. 2 claims. (Cl. 106-186.) The base is an ethylcellulose.

2,517,767. Shipping and display box. Richard J. Cody, assignor to Federal-Mogul Corporation, Detroit, Mich. Filed Jan. 28, 1948. 1 claim. (Cl. 229-42.) A carton adapted to the packaging of crankshaft bearings.

2,517,801. Packaging structure. John H. Roush, Johnson County, Kansas. Filed Sept. 6, 1946. 1 claim. (Cl. 229-51.) The package has an adhesively coated tearing strip.

2,517,832. Apparatus for purifying fibrous suspensions. Finn Blikstad and Erling Pedersen, Sarpsborg, Norway. Filed

Jan. 10, 1946. 2 claims. (Cl. 92-28.) This patent covers a sandtrap.

2,517,843. Combination advertising and return order blank. Charles B. Cochran, Baltimore, Md. Filed April 21, 1947. 1 claim. (Cl. 229-92.1.)

2,518,014. Carton folding machine. William H. Inman, assignor to Bloomer Bros. Company, Newark, N. Y. Filed Aug. 9, 1946. 16 claims. (Cl. 93-49.)

2,518,075. Apparatus for winding tubes. Wayne R. Scherer, assignor to Taylor Fibre Co., Norristown, Pa. Filed March 1, 1946. 5 claims. (Cl. 93-81.) Tubes are formed from paper impregnated with a synthetic resin.

2,518,084. Apparatus for separating relatively heavy particles from liquid. Charles W. Smith, Muskegon, Mich. Filed July 23, 1945. 7 claims. (Cl. 92-28.) This covers a sandtrap.

2,518,104. Apparatus for drying material in the form of webs. Sven Wellmar, assignor to A. B. Svenska Fläktfabriken, Stockholm, Sweden. Filed Sept. 27, 1946. 9 claims. (Cl. 34-159.) A channel drier.

2,518,241. Preservative compositions for cellulosic materials. James F. McCarthy, assignor to Treesdale Laboratories, Inc., Allegheny County, Pa. Filed May 29, 1945. 1 claim. (Cl. 260-19.) A flame- and waterproofing composition contains chlorinated paraffin, phenol-formaldehyde resin, calcium carbonate, antimony oxide, aluminum stearate, and a solvent.

2,518,281. Laminated structure and adhesive therefor. Thomas P. Camp and Chester N. Kolmodin, assignors to United States Gypsum Company, Chicago, Ill. Filed July 24, 1943. 5 claims. (Cl. 154-45.9.) Gypsum boards are laminated with an emulsified asphalt and a partially dextrinized starch.

2,518,350. Testing of materials by impact. John M. McCormick, assignor to Frank W. Preston, Butler, Pa. Filed Dec. 8, 1948. 6 claims. (Cl. 73-12.) This patent covers an impact tester for board and like materials.

August 15, 1950

2,518,438. Protective coatings. Helen S. Beretvás, assignor to Nox-Rust Corporation, Chicago, Ill. Filed Nov. 5, 1945. 11 claims. (Cl. 106-243.) A liquid, corrosion-inhibiting composition designed to give a resinlike coating contains calcium and zinc naphthenate and a tall oil soap.

2,518,550. Packaging material. Charles Q. Ives, Reading, Mass. Filed Feb. 18, 1948. 7 claims. (Cl. 154-55.) Corrugated board is rendered flexible by the incorporation of a tile-like facing ply whose surface consists of individual, separated, frustopyramidal segments.

2,518,680. Wood pulp. Kenneth R. Gray, assignor to Rayonier Incorporated, Shelton, Wash. Filed June 22, 1945. 5 claims. (Cl. 260-212.) Wood pulp is improved by the addition of free fatty or resin acids and the glycerides or esters of the higher alcohols and cholesterol or phytosterol.

2,518,681. Package carrier. Pearl M. Griffin, Hallock, Minn. Filed Jan. 2, 1948. 7 claims. (Cl. 229-52.) A carton has a flexible cord handle.

2,518,721. Pulp decoy. Arthur H. Risch, assignor to Pulp Reproduction Company, Milwaukee, Wis. Filed May 10, 1947. 2 claims. (Cl. 43-3.) The decoy is formed of molded pulp.

2,518,740. Method and apparatus for drying and curing felts. Charles B. Albright, assignor to The Orr Felt & Blanket Company, Piqua, Ohio. Filed Feb. 3, 1947. 10 claims. (Cl. 34-24.) A continuous process is described for drying and curing a resin in a papermakers' felt.

2,518,762. Cured meat wrapper. Ernest C. Draheim, assignor to Daniels Manufacturing Company, Rhinelander, Wis. Filed Dec. 19, 1946. 3 claims. (Cl. 154-50.) The wrapper consists of a parchment or kraft sheet, a creped, absorbent cushion layer, and an interior barrier layer of glassine or cellophane, bonded with an amorphous wax.

2,518,779. Display carton. Russell J. Hennessey, assignor to Waldorf Paper Products Company, St. Paul, Minn. Filed Jan. 26, 1946. 1 claim. (Cl. 206-45.) A carton for rolls of tape or the like.

2,518,806. Apparatus and method of manufacturing board. Carl G. Muench, assignor to The Celotex Corporation, Chicago, Ill. Filed Oct. 20, 1943. 7 claims. (Cl. 18-10.) A sheet containing 2 to 12% of added binder material is heated at 400°F. and 200 to 800 p.s.i.

2,518,814. Method and means for the separation of fibers suspended in a liquid. Lars E. Pentén, assignor to Leje & Thurne Aktiebolag, Stockholm, Sweden. Filed Jan. 30, 1945. 9 claims. (Cl. 210-53.) A fiber suspension admixed with air and flocculating substances is introduced into a tank in which the fibers accumulate on the surface of the liquid in the form of flocks.

2,518,818. Carrier. William A. Ringler, assignor to The Gardner Board and Carton Co., Middletown, Ohio. Filed June 11, 1945. 7 claims. (Cl. 229-52.) This covers a carton suitable as a fruit basket.

2,518,959. Apparatus for testing the crush strength of paper. Malcolm H. Tinker, assignor to B. F. Perkins & Son, Inc., Holyoke, Mass. Filed July 21, 1948. 2 claims. (Cl. 73-94.) This covers a bursting strength tester similar to that of U. S. patent 1,758,688 (May 13, 1930).

2,519,036. Method of molding cellular articles. Henry Ford and Robert A. Boyer, assignors to Ford Motor Company, Dearborn, Mich. Filed Aug. 11, 1943. 5 claims. (Cl. 154-118.) A method of molding a paper-base laminate.

2,519,102. Method and apparatus for sealing containers. Samuel Bergstein, Cincinnati, Ohio, assignor to Robert M. Bergstein and Frank D. Bergstein, as trustees. Filed Nov. 22, 1946. 17 claims. (Cl. 93-6.)

2,519,105. Drier roll for paper, paperboard, and like material. Arthur A. Blue, Fairfield, Conn. Filed Aug. 14, 1947. 8 claims. (Cl. 34-100.) The cylindrical barrel of the drier roll is constructed of a chromium-copper alloy which has a high rate of heat transfer.

2,519,111. Machine for folding box blanks and the like. Fred H. Chapman, assignor to The International Paper Box Machine Company, Nashua, N. H. Filed Oct. 8, 1945. 17 claims. (Cl. 93-49.) A tab-folding mechanism.

August 22, 1950

R 23,257. Container. Melvin T. Hunsworth, assignor to Container Corporation of America, Chicago, Ill. Original No. 2,488,194, dated Nov. 15, 1949. Application for reissue May 2, 1950. 14 claims. (Cl. 229-23.)

2,519,355. Scoring roller. Herbert F. Cox, Jr., assignor to American Can Company, New York, N. Y. Filed April 1, 1946. 4 claims. (Cl. 93-58.1.)

2,519,405. File folder. Charles I. Schwinger, Berwyn, Md. Filed Oct. 30, 1945. 3 claims. (Cl. 229-72.) An envelope-type record folder.

2,519,566. Superheater for chemical recovery units. Alexander L. Hamm, assignor to Combustion Engineering-Superheater, Inc., New York, N. Y. Filed Nov. 10, 1945. 8 claims. (Cl. 122-476.) A chemical recovery furnace for the processing of black liquor incorporates a bank of superheater tubes.

2,519,831. Carton. William P. Frankenstein, Cincinnati, Ohio. Filed Feb. 15, 1945. 15 claims. (Cl. 229-34.) The outer walls of a folding carton are arranged to form the frustum of a cone.

2,519,903. Removal of the sodium salt of lignoceric acid and other material from a tall oil soap. Torsten Hasselstrom, assignor to U. S. Industrial Chemicals, Inc., New York, N. Y. Filed July 17, 1947. 8 claims. (Cl. 260-97.7.) Tall oil is diluted to about 25% solids with water or an alcohol and the mixture is allowed to settle.

August 29, 1950

2,520,126. Expansible shaft. Lewis L. Collard, assignor to Crown Zellerbach Corporation, San Francisco, Calif. Filed Jan. 30, 1948. 8 claims. (Cl. 242-72.) A winder incorporates an expansible winder shaft; the expansion or contraction of the outer surface or shell sections of the shaft is controlled by pneumatic pressure.

2,520,252. Reversing mechanism for skids of paper. Grover C. Mutchler, Easton, Pa. Filed Aug. 1, 1946. 5 claims. (Cl. 214-115.) An apparatus for reversing piles of paper in bulk.

2,520,303. Knockdown shipping container. Leonard W. Bauer, Paterson, N. J. Filed Oct. 26, 1946. 9 claims. (Cl. 229-23.) A container for washing machines and the like.

2,520,320. Process and apparatus for wetting kaolin and the like. Sanford C. Lyons and Erwin G. Dallmus, assignors to Georgia Kaolin Company, Elizabeth, N. J. Filed Sept. 27, 1945. 8 claims. (Cl. 241-20.) A method of converting solid clay to a slurry.

2,520,327. Cylinder mold papermaking machine. Clifton N. Nilson, assignor to Cheney Bigelow Wire Works, Springfield, Mass. Filed May 17, 1947. 2 claims. (Cl. 92-43.) A cylinder mold is so constructed that the water in the fibrous mat passes inwardly to the mold and the mat adheres to the screen.

2,520,449. Transparent protective and display envelope. Amos F. Allen, Newark, N. J. Filed March 6, 1947. 2 claims. (Cl. 229-71.) An envelope consists of a longitudinal body of flexible transparent sheet material.

2,520,768. Coating roller adjusting mechanism. Joseph Kunicki, assignor to Arthur Tickle Engineering Works, Inc., Brooklyn, N. Y. Filed June 17, 1947. 6 claims. (Cl. 91-50.) The rolls of a coating or printing machine can be removed from contact with one another for cleaning or washing.

2,520,786. Machine for testing elongation. David C. Scott, assignor to Scott Testers, Inc., Providence, R. I. Filed May 21, 1946. 4 claims. (Cl. 73-95.)

September 5, 1950

R 23,266. Carton. Manville Thomas, assignor to Marathon Corporation, Rothschild, Wis. Original No. 2,505,442, dated

April 25, 1950. Application for reissue July 7, 1950. 5 claims. (Cl. 229-33.)

2,520,900. Coated paper and method of making same. Frederick H. Frost, assignor to S. D. Warren Company, Boston, Mass. Filed July 29, 1946. 15 claims. (Cl. 117-71.) A method of preparing aluminum coated paper.

2,520,915. Preparation of sodium chlorite. George L. Cunningham and Frank Pretka, assignors to Diamond Alkali Company, Cleveland, Ohio. Filed April 26, 1945. 3 claims. (Cl. 23-85.)

2,521,007. Tube making machine. Ferdinand Heinmets, Allenwood, Pa. Filed Dec. 20, 1944. 6 claims. (Cl. 93-82.) A strip of sheet material is bent around the mandrel and the formed tube is moved over the free end of the mandrel.

2,521,090. Fruit packer. Harold D. Pinkstaff, assignor of 50% to Clyde Lester, Sanger, Calif., and 50% to Paper Products Company, Visalia, Calif. Filed May 7, 1947. 1 claim. (Cl. 229-42.) A U-shaped, foldable, fruit-supporting, and covering curtain is preferably formed of heavy paper or cardboard.

2,521,103. Vortex separator for paper pulp. Frederick W. Vickery, Guildford, England (deceased). Filed Nov. 8, 1949. 8 claims. (Cl. 92-28.) A vortex separator for paper pulp includes means for the automatic continuous extraction of dirt and the like from a large hole on the bottom of the separator by an extractor.

2,521,110. Glue applying apparatus for paper cup making machines. Paul E. Wixon, Reisterstown, and Clarence E. Chapman, Baltimore, Md., assignors to Joseph Shapiro. Filed July 11, 1949. 4 claims. (Cl. 91-12.)

2,521,187. Bag machine and method. Francis T. Robinson, assignor to Arkell Safety Bag Company, New York, N. Y. Filed Oct. 20, 1945. 6 claims. (Cl. 93-18.) The bag material comprises two plies of crinkled paper, which are separately crinkled and laminated by means of an asphaltic or other suitable adhesive.

2,521,208. Hermetically sealed end closure for containers. Wilfred A. Eaton, assignor of one half to Ex-Cell-O Corporation, Detroit, Mich. and one half to Ace Carton Corporation, Chicago, Ill. Filed Dec. 6, 1945. 18 claims. (Cl. 229-5.5.) The end flaps of a container incorporate a number of pockets which are designed to receive and confine a surplus of flowable adhesive.

2,521,261. Papermaking machine. Drexel V. Smith and George W. Miles, Mobile, Ala. Filed Feb. 21, 1947. 8 claims. (Cl. 92-44.) The invention relates to the construction of a headbox, a pulp outlet spout, top and bottom slices, and methods for supporting and actuating them.

2,521,371. Dipper for grooved drier drums. Lloyd Hornbostel and John E. Goodwillie, assignors to Beloit Iron Works, Beloit, Wis. Filed May 8, 1946. 6 claims. (Cl. 34-125.) A drier drum incorporates an internally ribbed drier shell; a dipper extends into valleys between the ribs.

2,521,413. Web tension control means. Joseph S. Scheuermann and Thomas N. Carter, assignors to Cameron Machine Company, Brooklyn, N. Y. Filed Nov. 16, 1944. 1 claim. (Cl. 242-75.) A rewinder incorporates a power device for the carriage that supports the tension-control roll; the device is operated and controlled by air pressure.

2,521,446. Treatment of cellulose. Howard M. Buckwalter and Phillip D. Montgomery, assignors to United States Rubber Company, New York, N. Y. Filed Jan. 11, 1950. 8 claims. (Cl. 117-136.) Cellulose fibers are treated with up to 0.5% aqueous guanazole solution to improve its heat resistance.

2,521,532. Lignin resins and process of making same. Harry A. Mitman and Raymond N. Evans, assignors to Masonite Corporation, Laurel, Miss. Filed July 27, 1946. 5 claims. (Cl. 260-17.4.) The resin is formed from lignin, furfural, and formaldehyde with an acid catalyst.

2,521,554. Method of making paper-covered veneer. Richard N. Ware, Jr., and Reginald Cannon, assignors to Chicago Mill and Lumber Company, Chicago, Ill. Filed July 16, 1947. 3 claims. (Cl. 154-132.) A method of adhering kraft paper to wood veneer.

2,521,613. Mailing tube closure. Jacob Surks, Brooklyn, N. Y. Filed Jan. 22, 1947. 3 claims. (Cl. 229-43.) A paper end closure for a mailing tube.

2,521,625. Molding apparatus. Frank H. Benge, assignor to Continental-Diamond Fibre Company, Newark, Del. Filed Jan. 10, 1949. 15 claims. (Cl. 18-16.)

2,521,666. Porous web treating apparatus. George D. Knight and Ben W. Rowland, assignors to The Institute of Paper Chemistry, Appleton, Wis. Filed March 27, 1948. 4 claims. (Cl. 91-43.) This is a continuation of U. S. patent 2,471,330 and refers to an automatic coating machine for coating or impregnating one or both sides of a rapidly moving paper web.

September 12, 1950

2,521,735. Paper machine drier. Bernard A. Malkin, assignor to Dominion Engineering Works Limited, Lachine, Quebec, Canada. Filed Oct. 4, 1948. 2 claims. (Cl. 34-121.) The drier cylinders are driven by a gear train enclosed by a gear-housing assembly which is mounted independently of the drier frame in which the spindles of the drier are journalled.

2,521,989. Carton. Donald W. McPherson, Huntington Park, Calif. Filed Oct. 17, 1949. 4 claims. (Cl. 229-23.) A self-sealing carton with a dry latex adhesive.

2,522,049. Carton. Jack Lang, assignor to Makdon, Inc., New York, N. Y. Filed Jan. 21, 1949. 6 claims. (Cl. 229-36.) A carton includes a platform for displaying cosmetics and the like.

2,522,058. Container. Rupert P. Peters, Leamington Spa, England. Filed Nov. 6, 1945. 1 claim. (Cl. 229-4.5.) The liner has a paper wall and end disks of bitumen board with a filling orifice in one of such disks.

2,522,061. Liner, dispenser, and closure cover for cigarette packages. Gene Rioux, Pine Cove, Ontario, Canada. Filed March 19, 1948. 1 claim. (Cl. 206-41.2.)

2,522,154. Method and means for cutting, punching, blanking, and the like. Jes Asmussen, assignor to Marathon Corporation, Rothschild, Wis. Filed Feb. 24, 1947. 12 claims. (Cl. 164-99.) The rotary apparatus includes means for removal of blanks from a rapidly moving web.

2,522,253. Dispensing package. Frank L. Broeren and George W. Holt, Jr., assignors to Marathon Corporation, Rothschild, Wis. Filed March 15, 1946. 3 claims. (Cl. 206-58.) A dispensing package for a roll of waxed paper.

2,522,295. Aquatic decoy. John H. Olsen, assignor to Pulp Reproduction Company, Milwaukee, Wis. Filed Dec. 29, 1945. 1 claim. (Cl. 43-3.) The decoy is made from molded pulp.

2,522,325. Traylike folding structure. Marshall I. Williamson, New Haven, Conn. Filed Nov. 9, 1946. 6 claims. (Cl. 229-32.) The container has a flat bottom and upstanding end and side walls which are outfolded to form a prismlike border structure.

2,522,438. Machine for producing caps for milk and other bottles and similar containers. Arthur G. Enock, Thame, England. Filed May 14, 1946. 4 claims. (Cl. 93-1.3.)

September 19, 1950

2,522,597. Folding cardboard box. Herbert S. Blandford, assignor to Medina Business Estate, Elmira, N. Y. Filed Oct. 1, 1947. 1 claim. (Cl. 229-35.) A folding cardboard box is constructed with double end walls.

2,522,598. Folding paper box construction. Herbert S. Blandford, assignor to Medina Business Estate, Elmira, N. Y. Filed Oct. 1, 1947. 2 claims. (Cl. 229-35.) The box has tabs which clamp a transparent sheet over a display opening.

2,522,857. Production of creped foil. Harold R. Butler, Toronto, Ontario, Canada. Filed Nov. 27,1948. 5 claims. (Cl. 154-33.05.) Metal foil is laminated to paper and passed over a heated creping roll.

2,522,868. Packaging wrapper. George W. Goodwin, Shaker Heights, Ohio. Filed Dec. 21, 1946. 1 claim. (Cl. 229-51.) A double-wrapper cigarette package.

2,522,950. Bottle-carrying carton. Margaret W. Keith, New York, N. Y. Filed Dec. 19, 1946. 3 claims. (Cl. 224-45.)

2,523,145. Shipping container. Stuart H. Robinson, Peekskill, N. Y., assignor of one half to Margaret R. Robinson. Filed Feb. 15, 1947. 3 claims. (Cl. 229-14.) An insulated container for shipping biological cultures, fresh yeast, butter, and the like.

2,523,203. Nonblocking, heat-sealing ethylcellulose coating composition and a wrapping sheet coated therewith. Robert C. Ernst and William B. Moore, Jr., assignors to The Dow Chemical Company, Midland, Mich. Filed Oct. 28, 1948. 3 claims. (Cl. 106-177.) The wrapping sheet consists of aluminum foil, paper, or the like coated with ethylcellulose, tricresyl phosphate, α-methylstyrene, and carnauba wax.

2,523,246. Folding box. Charles I. Elliott and Vincent R. Pantalone, assignors to National Folding Box Company, Inc., New Haven, Conn. Filed April 9, 1947. 2 claims. (Cl. 229-38.) A folding box is adapted for the packaging of sterile cotton and bandages.

2,523,250. Folding carton. Vincent R. Pantalone, assignor to National Folding Box Company, Inc., New Haven, Conn. Filed Feb. 17, 1947. 6 claims. (Cl. 206-45.) The carton forms a substantially square box when closed and a triple-tier display stand in the open condition.

2,523,251. Rounded cornered folding box. Vincent R. Pantalone and Marshall I. Williamson, assignors to National Folding Box Company, Inc., New Haven, Conn. Filed Aug. 17, 1949. 4 claims. (Cl. 229-16.) A box for the packaging of toilet soap and the like.

September 26, 1950

2,523,488. Folding box. Marshall I. Williamson, assignor to National Folding Box Company, Inc., New Haven, Conn. Filed June 8, 1946. 3 claims. (Cl. 229-37.) A siftproof folding box.

2,523,642. Fibrous pulp digester, Frederick G. L. Becker,

assignor to Cellulose Development Corporation Limited, Hatch End, England. Filed Jan. 12, 1944. 5 claims. (Cl. 92-7.) A chemical reaction tower for the chlorine process.

2,523,668. Carton. Arthur Read, Portland, Ore. Filed Sept. 15, 1947. 2 claims. (Cl. 229-17.) A paperboard milk carton with pouring spout.

2,523,718. Carton gluing and closing machine. Thomas E. Piazze, assignor to Shellmar Products Corporation, Chicago, Ill. Filed Sept. 27, 1946. 12 claims. (Cl. 93-44.1.)

2,523,719. Carton flap opening mechanism. Thomas E. Piazze, assignor to Shellmar Products Corporation, Chicago, Ill. Filed Sept. 27, 1946. 15 claims. (Cl. 93-6.)

2,523,985. Carrier for chimed cans. Thomas W. Foster, assignor to Container Corporation of America, Chicago, Ill. Filed July 22, 1949. 3 claims. (Cl. 224-45.)

2,523,986. Carrier for tapered top cans. Thomas W. Foster, assignor to Container Corporation of America, Chicago, Ill. Filed June 29, 1949. 7 claims. (Cl. 224-45.)

RECENT BOOKS

The Condensed Chemical Dictionary. 4th Ed. Edited by Francis M. Turner and revised and enlarged by Professor and Mrs. Arthur Rose, State College, Pa. 1950. New York. Reinhold Publishing Co. Cloth, 6 × 9, 726 pages. $10.

This dictionary is now familiar to thousands of chemists and production men throughout the world. The present edition contains 23,000 entries giving the latest information. The list of manufacturers who aided the editors speaks well of the commercial authenticity of the definitions. A single definition outline will illustrate the manner in which products are defined: Barium, peroxide—other names, trade names, properties, constants, deviation, grades, containers, uses, fire hazard, and shipping regulations.

Chemistry and Industry of Starch. 2nd Ed. Edited by Ralph W. Kerr, Corn Products Refining Co., New York. Academic Press, Inc. 1950. Cloth, 6 × 9, 719 pages. $11.50.

This 2nd revised and enlarged edition should meet a real demand since the 1st edition was quickly sold out and many were disappointed because they could not obtain copies. The new edition is about fifty per cent larger than the 1st, and follows the same plan of treatment.

The co-authors of Dr. Kerr include George V. Caesar, Huron Milling Co., Leo M. Christensen, Consultant, Ed. F. Degering, Armour Research Foundation, Dexter French, Iowa State College, Alexander Frieden, Pabst Brewing Co., Eric Kneen, Kurth Molting Co., J. M. Newton, Clinton Industries, and Garrish M. Severson, University of Nebraska. Dr. Frieden is a member of TAPPI.

As in the 1st edition the Chapter titles are Occurrence, Preparation, Properties, Reactions and Uses, and Analysis. A 30-page chapter is devoted to the use of starch in paper manufacture.

Advances in Colloid Science III. Edited by H. Mark, Polytechnic Institute of Brooklyn, and E. J. W. Verwen of Holland. New York. Interscience Publishers, Inc. 1950. Cloth 6 × 9, 384 pages. $7.50.

This is an advanced text written for students and specialists in the field of colloids. It includes such subjects as atomic forces of adsorption, surface chemistry and colloids, quantitative interpretation of the electrophoretic velocity of colloids, lyogels, ultracentrifugal sedimentation of polymolecular substances, fatigue phenomena in high polymers, and flotation.

The Organization of Industrial Scientific Research. 2nd Ed. By C. E. Kenneth Mees and John A. Leermakers, Eastman Kodak Co. McGraw-Hill Book Co., New York. 1950. Cloth, 6 × 9, 383 pages. $5.00.

The first edition of this book was written by Dr. Mees in 1920. The present book is entirely new and represents the great advances that have been made in thirty years. Members of TAPPI who attended the recent Testing Conference at the Eastman Kodak plant in Rochester, N. Y., were impressed with the obvious results of intensive research so effectively.

Included in the subject matter are the development of scientific organization, agencies for the conduct of industrial research and the organization and operation of industrial laboratories. In the latter, reference is made to the position of the laboratory in a company, internal organization of the laboratory, the staff, direction of research, transfer of research to production, reports, patents, publication and library, financial administration, supplies and services, and the design of laboratory building.

Colloid Science. By James W. McBain, formerly Editor, Coll. Sci. and Professor of Chemistry, Stamford University now Director, National Chemical Laboratories, Poona, India. Boston, D. C. Heath & Co. Trade Edition Distributors, Reinhold Pub. Co. 1950. Cloth, 6 × 9, 450 pages. $8.00.

Although this book is, by no means, elementary, it is written for chemists and physicists who are not necessarily expert in the field of colloids. At best, colloid science is a difficult subject to understand and the recent advances have necessitated a comprehensive treatment that is usually beyond the scope of the technologist who is not devoting all of his attention to the subject. The book is relatively free from mathematics and complex interpretations. It is written from the standpoint of a physical chemist who is convinced that the general laws of physics and chemistry prevail throughout this subject, that superimposed upon them are further laws of colloid science, and that all of these are operative in living organisms, governing much of their complex and fascinating behavior.

Such familiar colloid subjects as foams and emulsions, sorption, Brownian movement, ultrafiltration, gels, osmotic pressure, soaps, cellulose, rubber, proteins, clays, aerosols and polymers feature the subject matter.

Analytical Absorption Spectroscopy. Edited by M. G. Mellon, Purdue University. John Wiley & Sons, Inc. 1950. Cloth, 6 × 9, 618 pages. $9.00.

In keeping with the times "Analytical Absorption Spectroscopy," which deals with absorptimetry and colorimetry is the combined work of a number of contributors, each an expert in his field. These include L. J. Brady, W. B. Fortune, K. S. Gibson, E. R. Holliday, D. B. Judd, M. L. Moss, R. H. Muller, and E. I. Stearns.

The book is written from the viewpoint of what seems of most practical concern in a modern chemical testing and analytical laboratory. Among the subjects covered are: color comparators, filter photometers, photographic methods, infrared and ultraviolet spectrophotometers, and measurement and specification of color.

Copies of books reviewed in this issue may be obtained from the Book Department of the Technical Association of the Pulp and Paper Industry, 122 East 42nd St., New York 17, N. Y

Instrumentation Studies. LX. The Beach Puncture Tester

J. A. VAN DEN AKKER and W. A. WINK

The Beach puncture tester, an instrument for measuring the work required to pierce a paperboard with a pyramidal point, has been investigated with regard to principles of method and design. Fundamental measurements made upon the instrumental constants and scales showed the latter to be accurate. Frictional losses were found to be small and of such nature as to be allowed for, with one exception: an appreciable loss occurred because of the method of mounting of the auxiliary weights. A significant error was found in the displacement of the release mechanism when the auxiliary weights were added to the pendulum system. Strain-energy set up in the puncture arm was found to result in appreciable error. The effect of sharpness of the edges and point of the puncture head was investigated for a number of boards, and a consistent relationship between test results and sharpness was not found; this led to the conclusion that, whatever the ultimate significance of the instrumental reading, a difference between a pair of readings on different boards is not significant if less than several per cent. The influence on test results of thin films of tacky and lubricating materials was measured, and it was found that the nature of the surface of a specimen could, under certain conditions, affect the puncture work quite materially; doubt is expressed that differences of this origin reflect the relative abilities of two boards to withstand puncturing force. The effect of varying the size and angular orientation of the triangular sample aperture was observed with the view to establishing manufacturing tolerances on these variables. Several suggestions for the improvement of the instrument are presented.

Because of the war and other circumstances beyond our control, the publication of this work has been delayed since 1943, when the material was presented to the American Paper and Pulp Association in Report 38. Soon after the appearance of this Report, the General Electric Co. redesigned the puncture tester (the work reported herein having been done on a developmental model) and produced a new model known as the General Electric puncture tester. By happenstance, the manufacturer was about to begin redesign of the instrument when Report 38 was issued. The findings presented therein were checked by the manufacturer, who used them in the redesign, thus eliminating or minimizing the importance of the sources of error which had been revealed and studied.

Although the results of the study have been utilized, publication of this investigation is considered to be of value in recording the kind of experimental analysis that has been made of the puncture tester and which might well be made of other instruments in which a pendulum is employed for the measurement of energy expended in rupturing a material.

Since the appearance of Report 38, two publications on the use and interpretation of the General Electric puncture tester have appeared (*9*, *10*).

Boxboard containers used for overseas shipments of war and lend-lease materials must be capable of withstanding extremes of moisture and temperature, and rough handling (*1*). The testing of finished containers for their resistance to mechanical handling is generally done with apparatus designed to simulate conditions of use, such as the drop test (*2*), drum test (*3*), inclined plane impact test (*4*), and box compression test (*5*). Various tests of the physical properties of the boxboard itself have been devised. The latter class of tests is useful mainly in the control of the manufacture of board.

The recently developed Beach puncture tester (*6*) is well suited for use in the control laboratory, and it is possible that, by reason of its design, this tester may successfully predict the ability of a container to withstand puncturing blows (*6*, *7*).

The purpose of the study described in this report was to investigate the physics of the Beach puncture tester and to uncover sources of error.

THE INSTRUMENTAL METHOD

The Beach puncture tester has been thoroughly described elsewhere (*6*). The following brief description is presented for the convenience of the reader who is not interested for the moment in the technical and mathematical details of design. The Beach puncture tester pierces a panel of board under test with a pointed body and measures the amount of energy required to perform a complete puncture. As in the familiar Elmendorf tearing tester, energy is measured through potential energy change of a pendulum.

A schematic diagram of the instrument is shown in Fig. 1. A pointed, but blunt, pyramidal head (*P*) is mounted on a metal arm, which is bent into an arc of a circle. This head is shaped like the corner of a box—that is, the apex of a tetrahedron or pyramid in which the three intersecting edges form 90° angles. When the pendulum is held in its "cocked" position, the center of mass of the whole system is at the level of the axis of rotation. After release, the pendulum swings freely until the puncture head meets the specimen, and the puncture occurs. A small metal band carried behind the puncture head prevents the ruptured portions of the board from springing back and rubbing against the circular arm, so that the pendulum swings freely after puncturing the specimen. The pendulum reaches the end of its swing when its instantaneous potential energy is equal to the original potential energy minus the energy expended in puncturing the board, overcoming

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friction and setting up strain-energy in the apparatus. At this point the friction hand is over that part of the scale corresponding to the amplitude of the pendulum following the puncture, much in the way that the final amplitude of the Elmendorf tester determines the indication of the friction hand of that instrument. The scale indicates the work of puncture in units of $^1/_4$-inch-

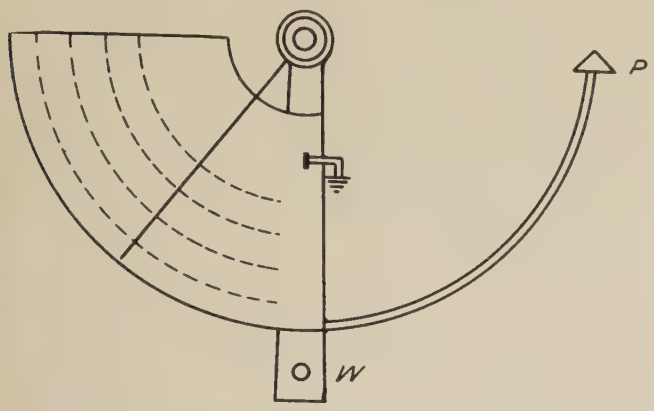

Fig. 1. Schematic drawing of the Beach puncture tester

pounds (that is, the work in inch-pounds is obtained by dividing the scale reading by four).* In much of the present work, scale readings are expressed in inch-pounds, and energies are computed in terms of inch-pounds.

Table I. Ranges of the Beach Puncture Tester

Auxiliary weights	*Work, in.-lb.*	*Work, $^1/_4$-in.-lb.*
None	50	200
A	100	400
A and B	200	800
A, B, and C	300	1200

Four ranges of the instrument are made possible by the addition to the pendulum (at W) of one, two, or all three auxiliary weights designated as A, B, and C. The magnitudes of the ranges are shown in Table I.

The stud which carries the auxiliary weights is so located that the striking speed of the pointed head is not affected by the addition or removal of the weights.

According to the original procedure the friction hand was set against a fixed, adjustable stop after "cocking" the pendulum. During the complete swing, energy was dissipated in the friction hand mechanism. Such energy may be allowed for, as in the Elmendorf-Thwing tearing strength tester, by adjusting the fixed stop. However, an adjustment of this stop holds for only one range, and must be changed each time the range is changed; moreover, the design of the instrument does not permit quick and easy adjustment of the stop. During the early stages of the present work, when frictional losses were under study, the suggestion was made by Beach (*8*) that error associated with energy loss in the friction hand mechanism could be made negligible by initially setting the hand at a scale reading somewhat in excess of the anticipated reading. Energy would then be dissipated in friction over an angle quite small compared with that of the total swing, and since uncertainties in the zero setting are not large when the whole swing is involved, errors which are due to friction in the hand mechanism would be satisfactorily small. This recommended procedure naturally requires that the hand stop be adjusted so that, with no specimen in place and the hand initially set at a value slightly in excess of the zero of the scale, the hand will be left in the zero position after a full, free swing. This method of adjusting the zero will tend to eliminate error caused by energy loss in other frictional effects.

* The scale of the puncture tester has since been modified.

TEST OF THE SCALES

The instrumental scales of this instrument should be in accord with the equation, work $= Wh \cos\theta$, where W is the weight (in pounds) of the pendulum system, h is the distance (in inches) from the center of mass of the system to the axis of rotation, and θ is the angle through which the pendulum swings past the vertical in coming to rest, following the puncture of the specimen. The scale was tested by measuring Wh, the chord distances from the zero of a scale to the divisions of the scale, and the radius of the scale. Angles corresponding to the linear distances were computed with the help of trigonometric relations and tables.

The quantity Wh was measured directly by supporting the pendulum in its initial position (center of mass on a level with the axis of rotation), and determining the thrust upon a vertical, supporting rod. The supporting rod was furnished with a knife edge, which contacted the pendulum at a distance R from the axis of rotation. The thrust was determined with a calibrated platform balance, the reading of which minus the weight of the thrust rod gave the vertical force F. It is clear that FR is equal to Wh. The averages for two sets of determinations of FR (utilizing different distances R) are given in Table II. These results were employed in the equation of the scale to give the final data of interest, which are presented in Table III.

Table II. Determination of Wh

Pendulum loading	Wh, *in.-lb.*
None	50.4
Weight A	100.3
Weights A and B	198.1
Weights A, B, and C	296.9

Examination of the data of Table III shows that the scales are generally accurate, occasional errors being of the order of 2%. Inspection of the scales (there are four scales on four different radii) indicated that the occasionally large errors were partly the result of the irregular spacing of the scale divisions.

FRICTIONAL ERRORS

As discussed in the introductory section of this report, error resulting from the dissipation of energy in the friction hand mechanism has recently been eliminated by following the procedure of initially setting the hand at a value slightly in excess of the anticipated scale reading. Even when the excess angle is greater than the largest sample-to-sample fluctuations (to guarantee that the hand stop will definitely contact the hand), the error is of no significance.

Friction in the pair of ball bearings could conceivably cause appreciable error. In the instrument studied, the work lost in bearing friction (including windage) was small, being of the order of 1 inch-pound. Proper setting of the friction hand stop, of course, would tend to eliminate this small error. In view of the possibility

Table III. Test of the Instrumental Scales

Theoretical energy, in.-lb.	*Actual scale reading, in.-lb.*	*Difference, in.-lb.*
First Scale (No Auxiliary Weight)		
25	24.3	−0.7
30	29.3	−0.7
35	34.2	−0.8
40	39.0	−1.0
45	44.0	−1.0
Second Scale (Weight A)		
45	44.5	−0.5
50	49.5	−0.5
60	59.0	−1.0
70	68.5	−1.5
80	78.4	−1.6
90	88.3	−1.7
Third Scale (Weights A and B)		
90	89.5	−0.5
100	99.7	−0.3
110	109.5	−0.5
120	119.6	−0.4
130	129.7	−0.3
140	139.5	−0.5
150	149.5	−0.5
160	159.3	−0.7
170	169.4	−0.6
180	178.2	−1.8
Fourth Scale (Weights A, B, and C)		
160	158.7	−1.3
170	168.3	−1.7
180	177.8	−2.2
190	189.5	−0.5
200	199.5	−0.5
210	208.0	−2.0
220	218.2	−1.8
230	228.5	−1.5
240	237.9	−2.1
250	249.3	−0.7
260	257.5	−2.5

that a gradual accumulation of grit in the bearings could ultimately result in appreciable bearing friction, it is suggested that the decrement of the pendulum in free oscillation be measured at regular intervals; corrective action should be taken when the decrement in amplitude is appreciably greater than that corresponding to about 1 inch-pound.

A significant loss of energy might occur in imparting rotation to the auxiliary weights upon the stud which supports them. If these weights were so tightly clamped that relative rotation would be impossible, no loss of energy could occur at the stud. A frictionless mounting would similarly avoid energy dissipation. However, there is a frictional torque for which the energy dissipation would be at a maximum. In the instrument studied, the auxiliary weights were not constrained from rotating when the nuts which prevent the weights from slipping off the stud were turned up tight. Relative rotation was actually observed, and the associated error, though probably not maximum, was appreciable. The errors observed by permitting a normal swing of the pendulum, followed by a swing in which the auxiliary weight or weights were tightly clamped, are given in Table IV.

The data of Table IV show that the error resulting from a loose mounting of the weights would be maximum at about 3.5%, for readings at the lower ends of the two highest ranges.

Table IV. Error Caused by Loose Mounting of the Auxiliary Weights

Auxiliary weight	*Energy loss, in.-lb.*
A	0.03
A and B	3.2
A, B, and C	5.7

Fortunately, the foregoing error can be eliminated easily by arranging the clamping of the auxiliary weights to prevent relative rotation of the weights on the stud. Means for automatically accomplishing this when the auxiliary weights are added should be provided with each instrument.

EFFECT OF STRAIN OF RELEASE MECHANISM

The release mechanism of the instrument studied was not sufficiently rugged to hold the pendulum in its horizontal position when the auxiliary weights were added. After tightening the anchorage of this mechanism to the frame and adjusting the pendulum to the horizontal position when free of the auxiliary weights, the depression of the pendulum caused by the addition of weights was accurately measured by means of a cathetometer. The frame of the instrument was very rigidly mounted to a stone-top table, and no displacement or rotation of the frame was observed. Upon translating the observed deflections to energy units in the respective scales, the following errors were found: weight A, 0.45 inch-pound; weights A and B, 1.61 inch-pounds; weights A, B, and C, 3.54 inch-pounds. It seems probable that the lack of rigidity of the present release mechanism is caused by the short lever arm of the catch.

The data given in the remainder of this report were obtained with an improvised release mechanism which, although too clumsy for routine control work, definitely maintained the pendulum at the proper release angle. The regular catch was tied in the release position, and a small post supported the pendulum at a point near the outer periphery. The post was jerked away when it was desired to release the pendulum.

STRAIN-ENERGY LOSSES

It is well known that an oscillating system can lose energy by imparting strain-energy to a nonrigid base or support. Any such possible loss of energy in the present work was rendered negligible by clamping the frame of the instrument to a stone-top table and forcing the slab of stone against a concrete wall. Users of pendulum-type instruments such as the Beach puncture tester, the Izod or Charpy impact tester, etc., are cautioned to mount these instruments rigidly on either very massive bases or on very rigid tables or supports.

An investigation was made of strain-energy losses in the instrument itself. Whereas no displacement of the main frame or specimen clamping mechanism could be observed, it was suspected that significant energy might be momentarily stored in the circular arm which carries the puncture head and that this strain-energy might

not be used in the process of puncturing the specimen but be dissipated in vibration of the arm during the free swing following the puncture.

The momentary bending of the arm during the puncturing of specimens was carefully investigated. Recordings of the radial deflections of the pointed head as it passed through specimens were made on a sooted steel surface. A flexible steel sheet was clamped to the frame at a point just below the specimen and to one side of the path taken by the puncture head when it contacts the lower face of the specimen. The plane of this sheet was perpendicular to the axis of rotation of the pendulum, and perpendicular to the plane of the specimen. A wire stylus was attached to the circular arm, at a point close to the puncture head. In this manner, a bright line was recorded on the sooted steel surface when the puncture head passed into and through the specimen. Permanent records were made by pressing a length of Scotch cellophane tape against the sooted surface. The adhesive picked up most of the soot, and the path traced by the stylus became a transparent line on the tape. Figure 2 shows a recording for a small time interval before, during, and after contact with the specimen, and indicates the radial bending away from the normal arc (the latter was obtained by recording in the absence of a specimen). The nearly straight-line recordings were obtained before inserting the specimens.

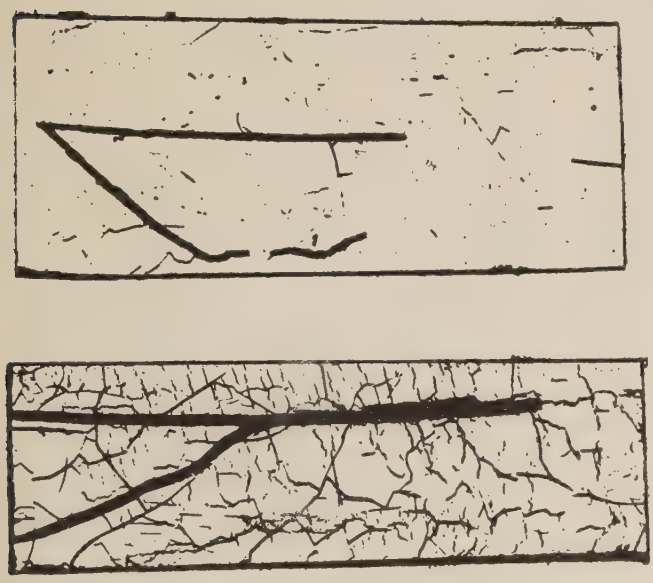

Fig. 2. Recording of motion of the puncture head during puncture

Study of the recordings showed that the displacement of the end of the arm was surprisingly large, often being of the order of $^{5}/_{16}$ inch (the exact value depending on the force required to puncture the board), and that the deflection of the arm was appreciable immediately following completion of the puncture. Rough estimates of the frequency of vibration of the arm corroborated the latter observation. This means that the strain-energy set up in the arm must be considered as a loss and, hence, also as an error.

The calculation of the strain-energy associated with the observed deflections requires a knowledge of the tangential deflections and of the tangential forces associated with the latter deflections. The necessary information was obtained by loading the puncture head with known vertical loads (with the pendulum in the position corresponding to contact of the head with a specimen) and measuring both the tangential (vertical) and radial (horizontal) displacements. The displacements are given as a function of the vertical loading in Fig. 3. Having measured the radial displacement from a recording, the corresponding tangential displacement x and vertical load w may be obtained from Fig. 3. It can be shown that the strain-energy is $0.5\ wx$.

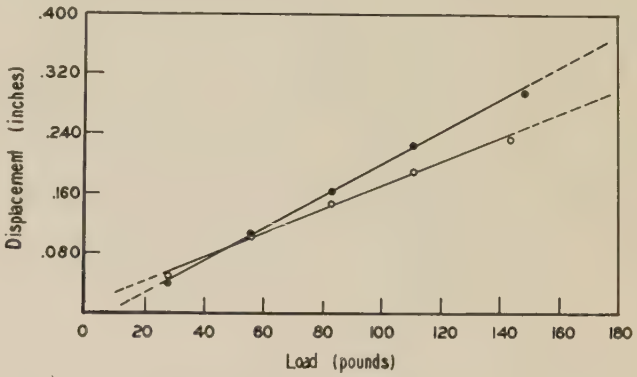

Fig. 3. Bending of puncture arm at various loads

Data were obtained for a number of samples of board covering a wide range of types, varying from tough (extensible) to hard and brittle. The calculated strain-energies, together with the scale readings, are given in Table V.

Table V. Error Caused by Strain-Energy in the Puncturing Arm

Scale reading, in.-lb.	*Strain-energy (error), in.-lb.*
75	3.6
87	6.0
100	7.5
142	12.7
147	8.6
150	9.4
155	9.4
158	9.4
160	12.7
165	14.2
169	9.4
170	14.2
197	12.7
203	16.6
207	12.7
210	17.8
212	22.4
215	14.8
217	12.7
220	15.8
222	18.3
225	29.7
230	16.6
237	20.1

Inspection of the data of Table V will show that the strain-energy is often of the order of 10% (in one case 13%) of the scale reading. Although there is a crude relationship between the scale reading and the error, the relationship is not consistent enough for reliability in

comparative work; there are a number of instances where the work of puncture increases and the error decreases by several inch-pounds. It is concluded, therefore, that the error from the loss of energy in deflection of the puncturing arm is of a serious nature.

Table VI. Board Samples Used in the Study of Edge and Point Sharpness

Sample	*Type of board*[a]
1	All kraft solid fiber (V-1)
2	Solid fiber, double asphalt, and chip filled (V-2)
3	600-lb. test all kraft double wall corrugated (outer wall A-flute, inner wall B-flute)
4	200-lb. test all kraft corrugated, A-flute
5	275-lb. test all kraft corrugated, A-flute
6	Jute outer liner 62 lb.; newsgrade corrugating 26 lb.; jute inner liner 62 lb., C-flute. Starch adhesive
7	Jute outer liner 62 lb.; straw corrugating 32 lb.; jute inner liner 62 lb., C-flute. Starch adhesive
8	Kraft outer liner 38 lb.; chestnut corrugating 26 lb.; kraft inner liner 38 lb., C-flute. Starch adhesive
9	Kraft outer liner 42 lb.; chestnut corrugating 26 lb.; kraft inner liner 42 lb., C-flute. Starch adhesive
10	Kraft outer liner 47 lb.; kraft corrugating 26 lb.; kraft inner liner 47 lb. Silicate adhesive
11	Jute outer liner; straw corrugating; jute inner liner, A-flute
12	Kraft outer liner; straw corrugating; kraft inner liner, A-flute
13	Jute outer liner; straw corrugating; kraft inner liner, B-flute
14	Jute outer liner; straw corrugating; jute inner liner, A-flute

[a] This information is given to indicate the range of board samples employed in the tests. The test results should not be taken as evaluation of the various materials listed

It should be pointed out that a radial deflection of the pointed head during puncture will probably cause error resulting from the displacement itself; there is no basis at hand for the estimation of this error.

It would seem feasible to replace the tubular puncturing arm with an arm having a greater radial thickness.

EFFECT OF SHARPNESS OF THE POINT AND EDGES OF THE PUNCTURE HEAD

The point and edges of the puncture head are rounded so that there will be no cutting effect. It was thought possible that the exact curvature of the point and edges might be important and, hence, the influence of curvature was carefully studied. A special puncture head was constructed from a solid block of steel. The dimensions of the base and the altitude of the tetrahedron were made closely similar to those of the head with which the instrument under investigation was equipped. The three puncturing faces were ground against a cast-iron lap with fine carborundum, so that the 90° edges and point were sharp. Following a series of measurements made with this degree of sharpness, the edges were ground with a special lap designed to impart a rounded edge of definite, known curvature. Each special lap was made by drilling a hole of the desired diameter in a block of cast iron and, by means of a shaper, removing metal until only a 90° arc of the hole remained. After rough grinding of an edge, this cylindrical groove enabled fine grinding of the rounded edge to the given curvature. A new curvature of slightly greater radius of curvature was imparted to the edges and point after a complete set of puncture tests was obtained with the previous curvature given to the edges and point. The radii of curvatures imparted were 0.00 (sharp), 0.012, 0.026, 0.036, 0.050, and 0.062 inch. The radii of curvature of the edges of the head provided with the instrument were 0.036, 0.050, and 0.062 inch, an average of about 0.050 inch.

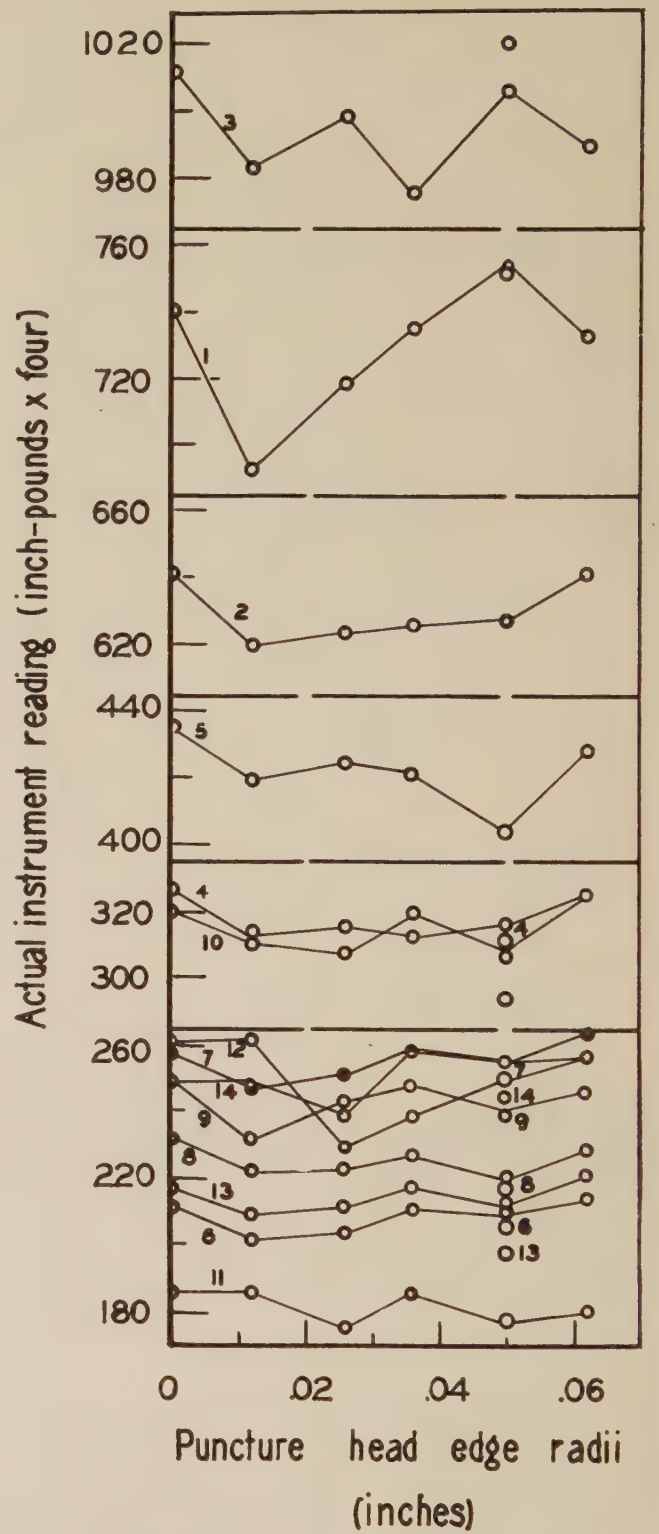

Fig. 4. Influence of instrumental reading of sharpness of the puncture head

Fourteen samples, selected as representative of the type of boards frequently tested with the puncture tester, were used in the study of edge and point sharpness. The nature of these samples is given in Table VI.

Measurements were made in the container testing laboratory, where the relative humidity and temperature are held constant at 50% and 73°F. The results are given in Table VII. Each datum is the average of 10 readings made in rotation on 10 specimens. All measurements for the different degrees of sharpness, and for a given sample, were made on the same specimens, in order that differences resulting from specimen variation would be minimized as far as possible. The standard error is seen to be satisfactorily small. The following precautions were exercised in conducting the tests: (a) the pendulum was set for horizontal release, as previously described; (b) the friction hand stop was properly set to insure a true zero reading for each combination of auxiliary weights employed; (c) the auxiliary weights were wedged to the stud to prevent rotation during the swing of the pendulum; (d) the friction hand was set slightly in excess of the actual reading to eliminate the pointer friction error. Apart from the minor imperfections of the instrumental scales, the only error not accounted for in this set of measurements is that caused by the bending of the puncture arm.

The data of Table VII are plotted in Fig. 4. Results obtained with the puncture head with which the instrument is equipped are designated with heavy dots.

The chart presented in Fig. 4 shows that there is no consistent relationship between the puncture work and the radius of curvature of the edges and point of the puncture head. Surprisingly, there is, as a rule, a drop in puncture work on going from the sharp head to the next step in dullness.

Although the changes in puncture work with sharpness or dullness are generally not large (the maximum being 14%), the variable nature of the relationships leads to variable ranking of samples. Samples 9 and 12, for example, are seriously inverted on going from a radius of curvature of edges and point of 0.012 to 0.026 inch. The sharper of these two heads places Sample 12 at a level 13.5% above sample 9, whereas the duller places sample 9 above sample 12 by about 5.5%. Since a rounded edge having a radius of curvature of 0.012 inch is certainly not "sharp," and might arbitrarily be used as well as the adopted radius of about 0.05 inch, it is seen that, whatever the ultimate significance of the puncture test may be, differences between test results on different boards are not significant if less than several per cent. Part of the erratic nature of the relationships between puncture work and sharpness of the head is, of course, purely statistical. The average standard error for the two radii mentioned above and sample 9 was 1.6%, and the corresponding error for sample 12 was 1.8%; according to statistical theory, the standard error in the difference between the results for these two samples is about 2.4%. It is very improbable that an accidental difference would be as large as three times this figure—that is, about 7.2%. Since there is a margin of several per cent between this last figure and the inversion from 13.5% in one direction to 5.5% in the other, it must be concluded that a significant instrumental difference is appreciably greater than the precision of the instrument.

It is expected that the flexure of the puncture arm plays a part in the uncertainty associated with sharp ness of the puncture head, and it is possible that the use of a stiffer arm would result in some consistency of relationship between puncture work and sharpness.

Table VII. Influence of Sharpness of the Puncture Point

Radius of curvature:	*0.00 Inch*		*0.012 Inch*		*0.026 Inch*		*0.036 Inch*		*0.050 Inch*		*0.062 Inch*		*Original point*	
Sample	*Reading*	*Standard error, %*	*Reading*	*Standard error, %*	*Reading*	*Standard error, %*	*Reading*	*Standard error, %*	*Reading*	*Standard error, %*	*Reading*	*Standard error, %*	*Reading*	*Standard error, %*
1	741	0.5	693	0.4	719	0.6	735	0.8	755	0.4	733	0.6	*752*	0.6
2	642	0.5	620	0.6	624	0.5	626	0.7	628	0.8	642	0.3	*627*	0.7
3	1012	0.6	984	1.2	999	0.9	976	1.1	1007	0.8	990	0.9	*1020*	1.2
4	327	0.8	313	0 8	316	1.6	313	1.6	317	1.0	326	1.3	*311*	1.6
5	436	1.0	420	1.3	425	0.7	422	1.8	405	1.5	429	1.8	*404*	0.9
6	212	0.9	202	1.3	204	0.8	211	1.1	210	0.9	214	0.7	*206*	0.4
7	257	0.9	247	1.7	251	0.9	259	1.2	255	1.5	264	1.1	*250*	1.2
8	232	1.0	222	1.1	223	1.6	227	1.1	220	1.2	229	0.9	*217*	0.7
9	250	1.4	231	1.8	243	1.3	248	0.9	241	0.9	246	1.1	*240*	1.2
10	320	0.7	311	0.7	308	1.0	320	0.6	309	1.4	325	0.6	*294*	1.0
11	186	2.1	186	1.0	175	1.1	186	2.2	178	2.0	181	1.4	*177*	1.0
12	261	2.5	262	1.2	230	2.3	239	1.8	250	1.0	257	2.2	...	...
13	217	0.8	209	1.6	211	0.8	217	1.6	212	1.0	221	1.4	*198*	1.4
14	249	1.6	249	1.9	239	1.3	258	2.3	255	2.3	257	1.6	*244*	2.7

Irrespective of significance of instrumental results, agreement between different instruments may be expected only when the radius of curvature of the edges and point of the puncture head is kept within small limits. It is estimated from the chart of Fig. 4 that the tolerance should be of the order of ±0.001 inch.

In attempting to explain why the puncture work with a sharp head should not be less than the work with a dull head, it was considered that, in the case of a sharp head, the three pointed sectors formed in the specimen during rupture bore more heavily upon the advancing triangular faces of the puncture head, thus maintaining the puncture work at a high value by increasing the frictional drag during the rupture. A study of the effect of variables relating to frictional drag during rupture is described in the next section.

EFFECT OF FRICTIONAL DRAG DURING RUPTURE

Part of the work of puncturing a board is the energy expended in overcoming frictional drag on the triangular faces of the puncture head. This, in turn, would be expected to depend upon the nature of the board surface. The nature of the surface of a number of specimens was

modified by the addition of thin films of a tacky material (asphalt) and three lubricants (paraffin, graphite, and cup grease).

Carbon tetrachloride was added to asphalt (melting at 200 to 205°F.) to give a consistency suitable for brushing. No appreciable penetration of the asphalt into the board specimens was observed. The graphite was also applied with carbon tetrachloride.

The paraffin was applied by melting and brushing. The paraffin solidified so quickly that penetration of the board was not deep.

The cup grease was simply smeared upon the surface to form a thin film. The grease was applied after a specimen was clamped in place, and immediately before releasing the pendulum, so that penetration would be inappreciable. In all other cases, the surface-treated specimens were permitted to "dry" and recondition for a period of 24 hours prior to testing. In the case of two samples, tests were made on the influence of carbon tetrachloride alone. It was evident that the pure solvent penetrated the board at a much greater rate than when used as a diluent with asphalt or graphite and, hence, any effect observed as being caused by this solvent was exaggerated in the tests with the solvent alone. The puncture head was cleaned with solvents prior to each test.

The results are given in Table VIII.

The asphalt film caused an appreciable increment in the puncture work. As regards interpretation of test results in use, it is problematical that this increment could be taken to mean that a board carrying a thin film of asphalt would withstand puncturing more strongly than an identical board having no film; for example, in a slow rupture the two boards would fail under about the same force and, even in a rapid rupture, the onset of rupture would occur at similar forces.

With the exception of the results for the solid fiberboard (sample 1), the films of graphite and cup grease did not cause significant reduction in the puncture work, which might mean that in some boards the effect of frictional drag is normally quite small. The ruptured portions of solid fiberboard drag more heavily upon the puncture head and, hence, the lubricant effects a greater reduction in puncture work. (The lighter pressure of the ruptured portions of the corrugated board is not of so much consequence in the effect of an asphalt film, because a tacky material can produce a large frictional drag force without the application of much pressure.)

ferent as regards surface friction, it is possible that the difference in observed puncture work would not be of significance from the viewpoint of the ultimate use of the boards.

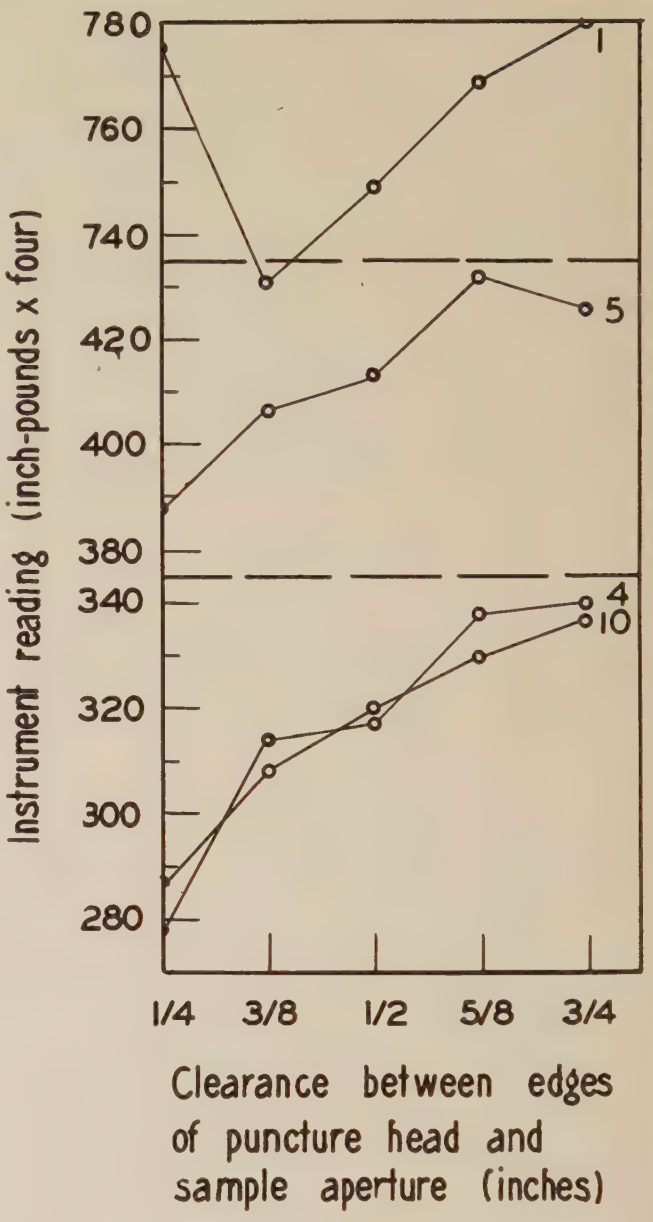

Fig. 5. Influence of instrumental reading of size of sample aperture

Table VIII. Effect of Frictional Drag

Surface treatment	Sample 1		Sample 4		Sample 5		Sample 8	
	Reading	Standard error, %	Reading	Standard error, %	Reading	Standard error, %	Reading	Standard error, %
None	719	0.6	284	1.2	388	1.4	204	0.7
Asphalt	808	0.9	362	0.9	473	1.2	259	1.6
Paraffin	693	0.7	301	1.2	399	1.2	208	1.1
Graphite	634	0.7	283	1.2	358	1.1	193	1.9
Cup grease	646	0.6	270	1.3	371	1.6	197	0.8
Carbon tetrachloride	681	0.6	279	1.3	...	...	...	...

We may conclude that the effect of the surface of the board under test may, or may not, be important, the exact effect depending upon the nature of the board and the tacky or lubricating nature of the surface. Where one compares two boards having surfaces quite dif-

EFFECT OF SIZE OF THE SAMPLE APERTURE

An essential part of the specimen clamping assembly is a self-aligning metal plate having a triangular opening. This template is clamped above the specimen and

Table IX. Effect of Size of Sample Aperture

Clearance:	1/4 Inch		3/8 Inch		1/2 Inch		5/8 Inch		3/4 Inch	
Sample	Reading	Standard error, %	Reading	Standard error, %	Reading	Standard error, %	Reading	Standard error, %	Reading	Standard error, %
1	775	0.9	731	1.0	749	1.0	769	0.4	780	0.6
4	278	1.4	314	1.4	317	1.3	338	1.6	340	1.6
5	388	0.9	407	1.0	413	0.7	432	1.6	426	1.2
10	287	0.9	308	1.0	320	0.7	330	0.6	337	1.6

serves to support the specimen up to a triangular area bounded by edges nominally 1/2 inch from the edges of the puncture head base (that is, 1/2-inch clearance between the head and triangular opening).

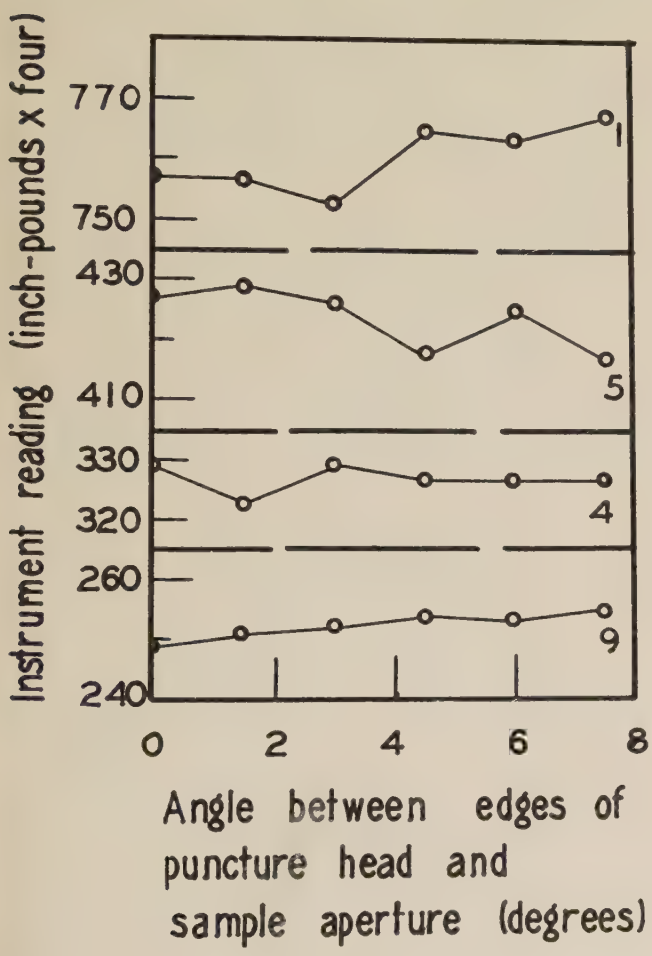

Fig. 6. Influence of instrumental reading of angular position of sample aperture

The nature of the relationship between test results and the size of the triangular sample aperture is of obvious technical importance: What size of opening is optimum as regards differentiation between samples, and within what tolerances should the triangular opening be cut? To investigate this relationship a special template was made, in which the first sample aperture was large and resulted in a clearance of 3/4 inch between the aperture and puncture head; the next size, a clearance of 5/8 inch; the next 1/2 inch (the same as the normal clearance); the next 3/8 inch; and the smallest opening involved a clearance of only 1/4 inch. A series of tests was made for each size of opening. The results are presented in Table IX and Fig. 5.

With the exception of the result for the solid fiber, sample 1, the puncture work consistently increases with increasing clearance. In the case of the solid fiberboard, the strain of the puncture arm must have caused the puncture head to deflect to small clearance with the aperture, thus spuriously increasing the puncture work through an abnormally large puncturing force. It seems clear that the increase in work with increasing clearance is to be associated with the greater distance of travel of the head during puncture. Inspection of the data shows that the adopted clearance of 1/2 inch is well chosen. The trends indicated in Fig. 5 show that a tolerance in the size of the angular aperture of about ±0.01 inch would eliminate significant error resulting from variations in size of the aperture. This tolerance would, of course, be easy to meet in manufacture.

EFFECT OF ANGLE BETWEEN THE SAMPLE APERTURE AND THE PUNCTURE HEAD

In one of the instruments studied, the three edges of the triangular aperture were not parallel to the edges of the base of the puncture head; there was an azimuthal rotation of a few degrees. A question regarding the importance of this imperfection was raised and investigated by studying the effect of rotation of the special aperture plate when the plate had the aperture of normal size (1/2-inch clearance). The results are shown in Table X and Fig. 6.

Inspection of the data of Table X leads to the conclusion that the test results are virtually independent of the angle between sample aperture and puncture head, for angles up to about seven degrees.

GENERAL REMARKS AND SUGGESTIONS FOR IMPROVEMENT OF THE INSTRUMENT

With the exception of certain features discussed earlier in this report, the design of the instrument appears

Table X. Effect of Angle Between the Sample Aperture and Puncture Head

Angle:	0°		1.5°		3.0°		4.5°		6.0°		7.5°	
Sample	Reading	Standard error, %	Reading	Standard error, %	Reading	Standard error, %	Reading	Standard error, %	Reading	Standard error, %	Reading	Standard error, %
1	757	1.0	757	0.7	753	0.7	765	0.6	764	0.7	768	0.6
4	329	1.2	323	1.2	329	1.7	327	1.1	327	1.7	327	1.1
5	427	0.8	429	1.7	426	1.6	418	1.1	425	1.5	417	1.5
9	249	1.2	251	1.8	252	1.2	254	1.5	253	1.7	255	1.5

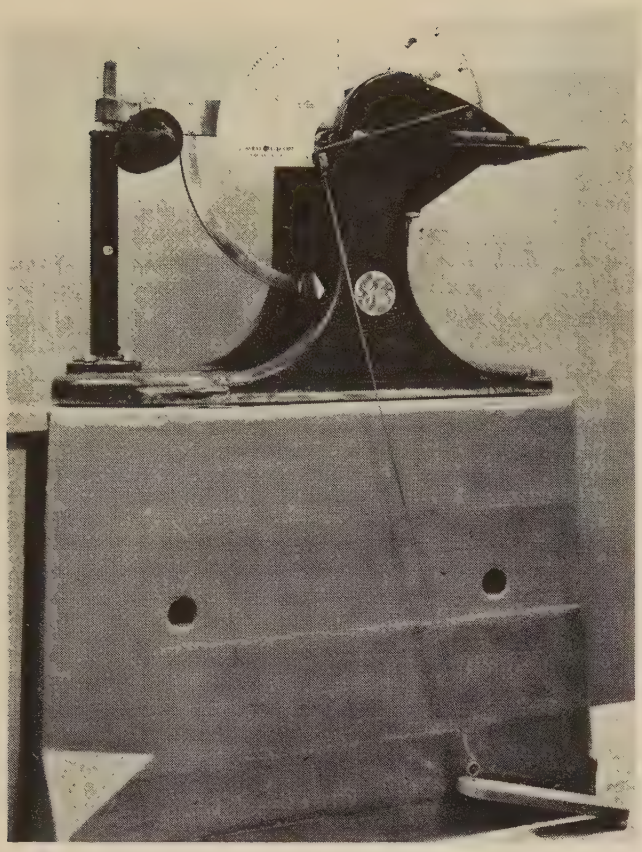

Fig. 7. The Beach puncture tester

to be very satisfactory. The main frame and sample clamping mechanism are very rugged. The pair of bearings on which the pendulum is mounted are rather close together, and there is some chance that difficulty resulting from misalignment of these bearings could be encountered. The light metal collar which is carried on the puncturing arm and serves to hold the three ruptured portions of the specimen from rubbing against the arm sometimes fails in its purpose. When this occurs, energy is dissipated in friction, and an erroneously high result is obtained. The failure of this collar to prevent rubbing of the specimen against the puncturing arm occurred most frequently when solid fiberboard was under test.

The following suggestions for improvement of the instrument are made:

1. Means should be provided for simple and quick checking of the zero of the instrument when auxiliary weights are employed.

2. The means for mounting the auxiliary weights should be so designed that the weights are restrained from rotation.

3. A more rugged release mechanism should be provided. This mechanism should be of such rigidity that no significant depression of the pendulum occurs when all three auxiliary weights are added.

4. The stiffness of the puncture arm should be increased about tenfold.

5. The radius of curvature of the edges and point of the puncture head should be held to an arbitrarily adopted value (e.g., 0.050 inch) with a tolerance of about ±0.001 inch.

6. The triangular aperture for the sample should be cut to a standard size with a tolerance of about ±0.01 inch.

7. The design of the collar serving to hold the ruptured specimen from contacting the puncture arm should be modified to perform satisfactorily when solid fiberboards are tested.

The present instrument, which incorporates the above suggestions, is shown in Fig. 7.

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- Program Chairman—Alfred D. Bonanno, Champion-International Co., Lawrence, Mass.

Sixth Engineering Conference of the Pulp and Paper Industry, General Oglethorpe Hotel, Wilmington Island, Savannah, Ga., October 15–18, 1951
- General Chairman—George H. Pringle, Mead Corp., Chillicothe, Ohio.
- Local Arrangements Chairman—James R. Lientz, Union Bag & Paper Co., Savannah, Ga.

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Ohio Section:
January 9, 1951, Manchester Hotel, Middletown, Ohio.
February 8, 1951, Manchester Hotel, Middletown, Ohio.
March 8, 1951, Manchester Hotel, Middletown, Ohio.

Pacific Section:
February 6, 1951, Olympia, Wash.
April 13, 1951, Longview, Wash.

New England Section:
January 19, 1951, Roger Smith Hotel, Holyoke, Mass.

Lake Erie Papermakers and Converters:
January 19, 1951, Hickory Grill, Cleveland, Ohio.
February 16, 1951, Hickory Grill, Cleveland, Ohio.

Delaware Valley Section:
January 25, 1951, Engineers Club, Philadelphia, Pa.
March 22, 1951, Engineers Club, Philadelphia, Pa.

Chicago Section:
December 18, 1950, Chicago Bar Association, Chicago, Ill.
January 15, 1951, Chicago Bar Association, Chicago, Ill.

Kalamazoo Valley Section:
January 18, 1951, Park American Hotel, Kalamazoo, Mich.

Metropolitan Group, Empire State Section:
January 9, 1951, Fraunces Tavern, New York, N. Y.
March 6, 1951, Fraunces Tavern, New York, N. Y.

Northern Group, Empire State Section:
January 11, 1951, Woodruff Hotel, Watertown, N. Y.
February 8, 1951, Woodruff Hotel, Watertown N. Y.
March 8, 1951, Woodruff Hotel, Watertown, N. Y.
April 12, 1951, Woodruff Hotel, Watertown, N. Y.
May 10, 1951, Woodruff Hotel, Watertown, N. Y.

Lake States Section:
January 9, 1951, American Legion Clubhouse, Appleton, Wis.
March 13, 1951, Stevens Point, Wis.

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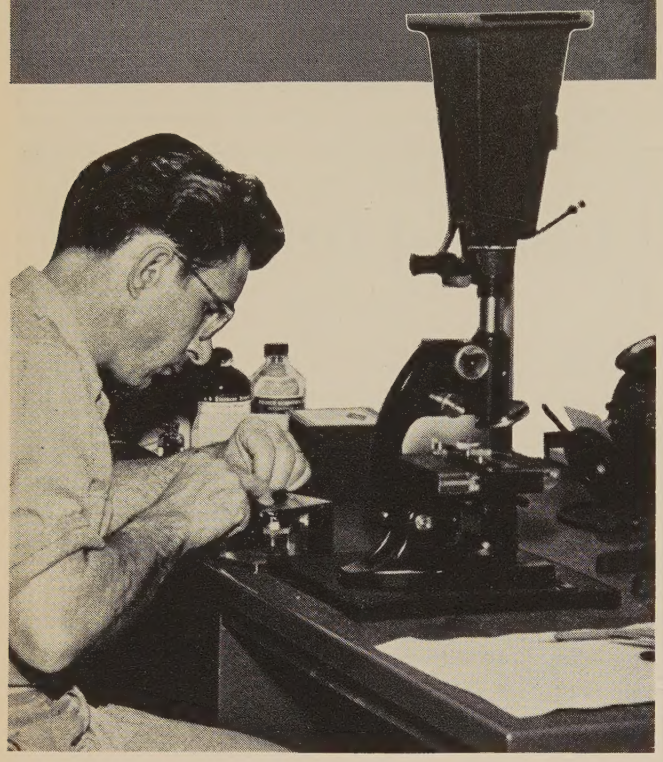

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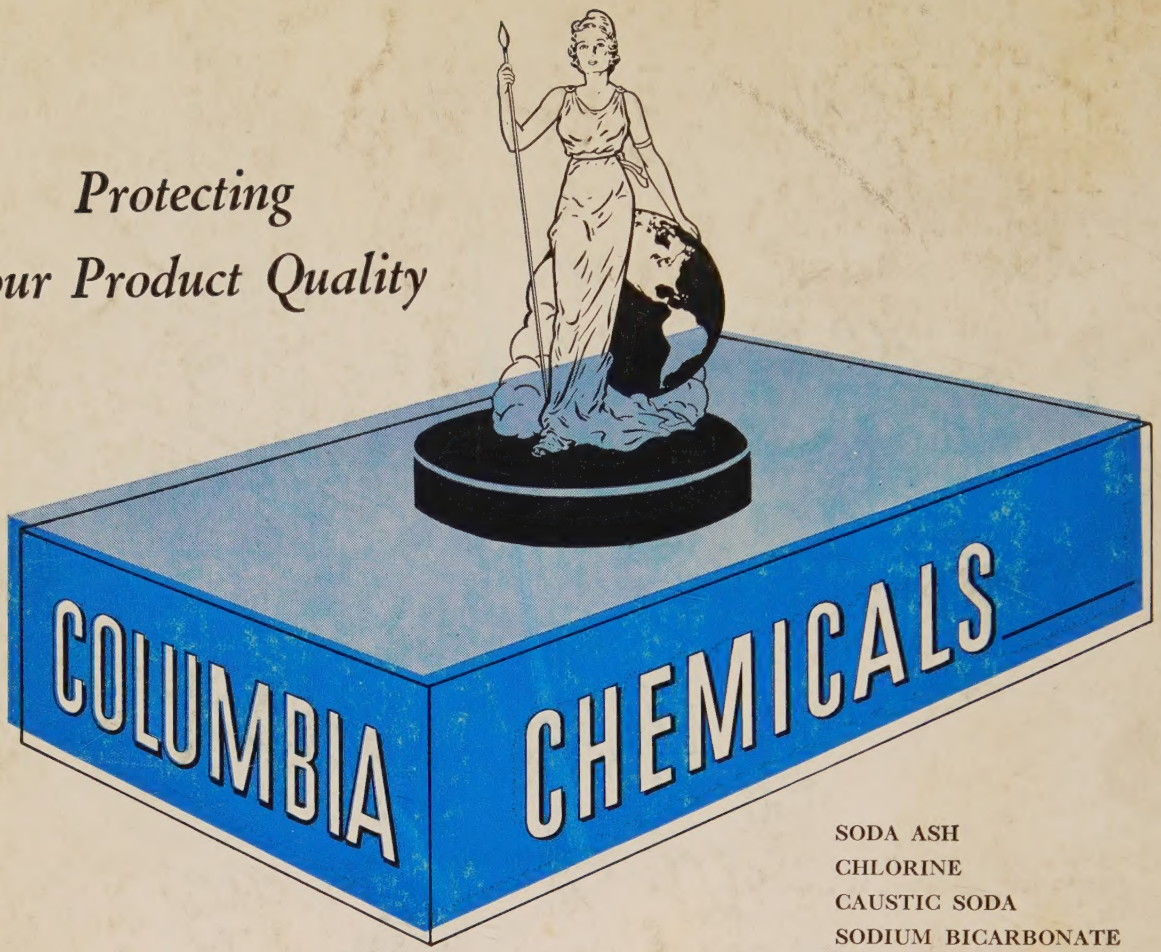

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